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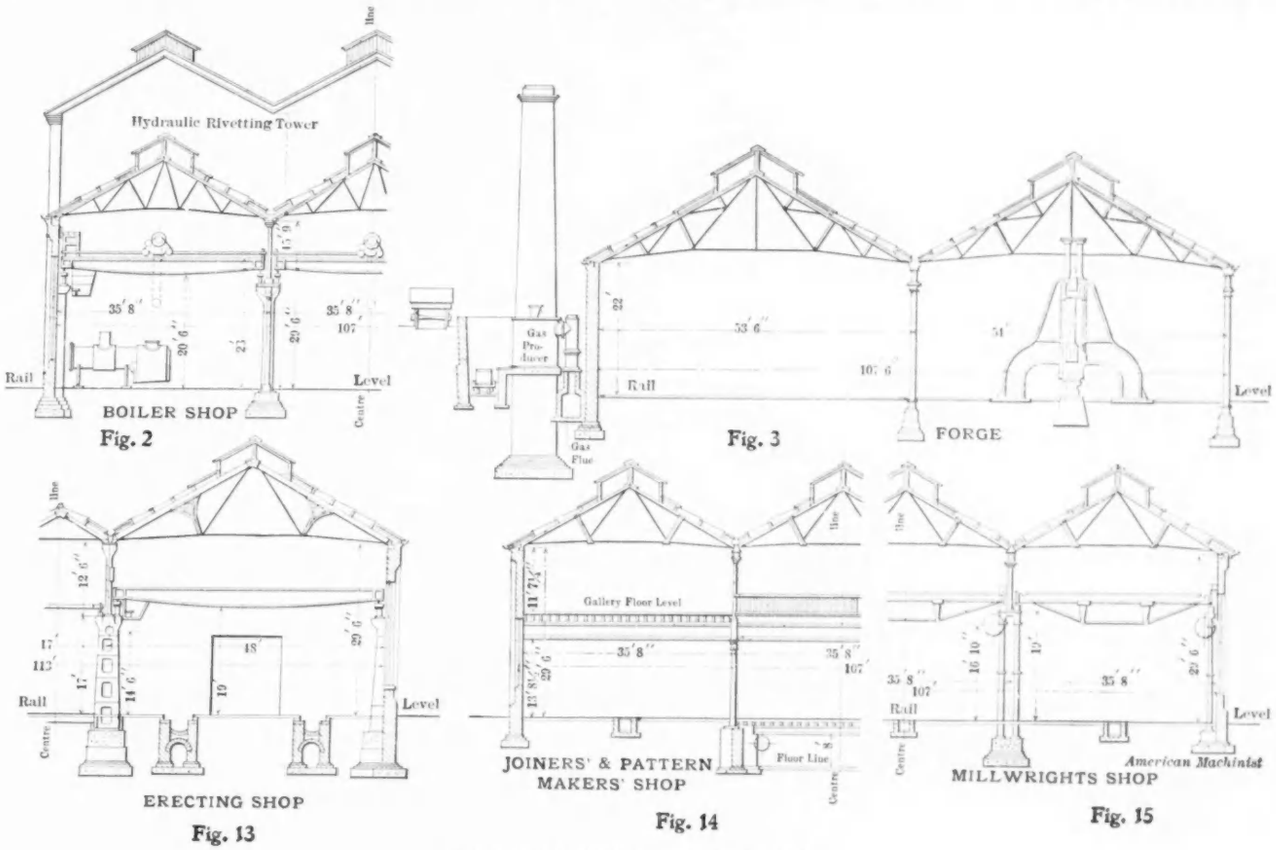
The Horwich Shops of the Lancashire & Yorkshire Railway.—I.

The Lancashire & Yorkshire Railway runs across England from Liverpool and Fleetwood on the west to Goole and Hull on the east coast. The capital invested by the company is in round numbers $250,000,000 and the length of the road is 549 miles. In 1894, which is the latest year for which I have the figures, the road had 1,201 locomotives, which worked in that year 10,037,276 passenger and 6,475,692 freight miles, with 3,884 passenger coaches and 23,833 freight cars. Previous to 1887 the company had two shops in which repairs and construction of rolling stock had been carried on, one at Miles Platting and the other at Bury. These becoming inadequate, it was determined to build new works and to build them in the best possible manner and with every known and approved device for efficiently carrying on the work, and the shops as they stand to-day are among the most interesting industrial establishments of the world. They were erected and are now carried on under the general supervision of Mr. J. A. F. Aspinall, chief mechanical engineer, who is well known in railway circles both here and in Great Britain as a particularly able, broad minded and progressive man, and the afternoon I spent with him, first by riding in his private combination coach and locomotive, at high speed, from Manchester to Horwich, and then in walking about the immense establishment where 3,600 employés work under exceptionally favorable conditions, is now remembered as one of the most pleasant experiences of my wanderings in England.

The ground inclosed for the shops comprises 96 acres, and 16½ acres of this are covered by the shop buildings, which are one story high, and, unlike too many British shops, have received especial attention in respect of heating, ventilation and lighting. Not only are the shops themselves admirable, but there are also, immediately adjoining them, a Mechanics' Institute and Technical High School, recreation grounds, gymnasium, cottage hospital and a large dining room, all maintained by the generosity of the company or of individuals interested in it.

The Mechanics' Institute was opened in 1888 and enlarged in 1893. At its beginning the shareholders of the road voted $25,000 to establish it, and Mrs. Samuel Fielden, of Todmorden, the widow of a former director, added to it the "Samuel Fielden" wing. In the building there is an auditorium capable



HORWICH SHOPS L. & Y. RAILWAY.

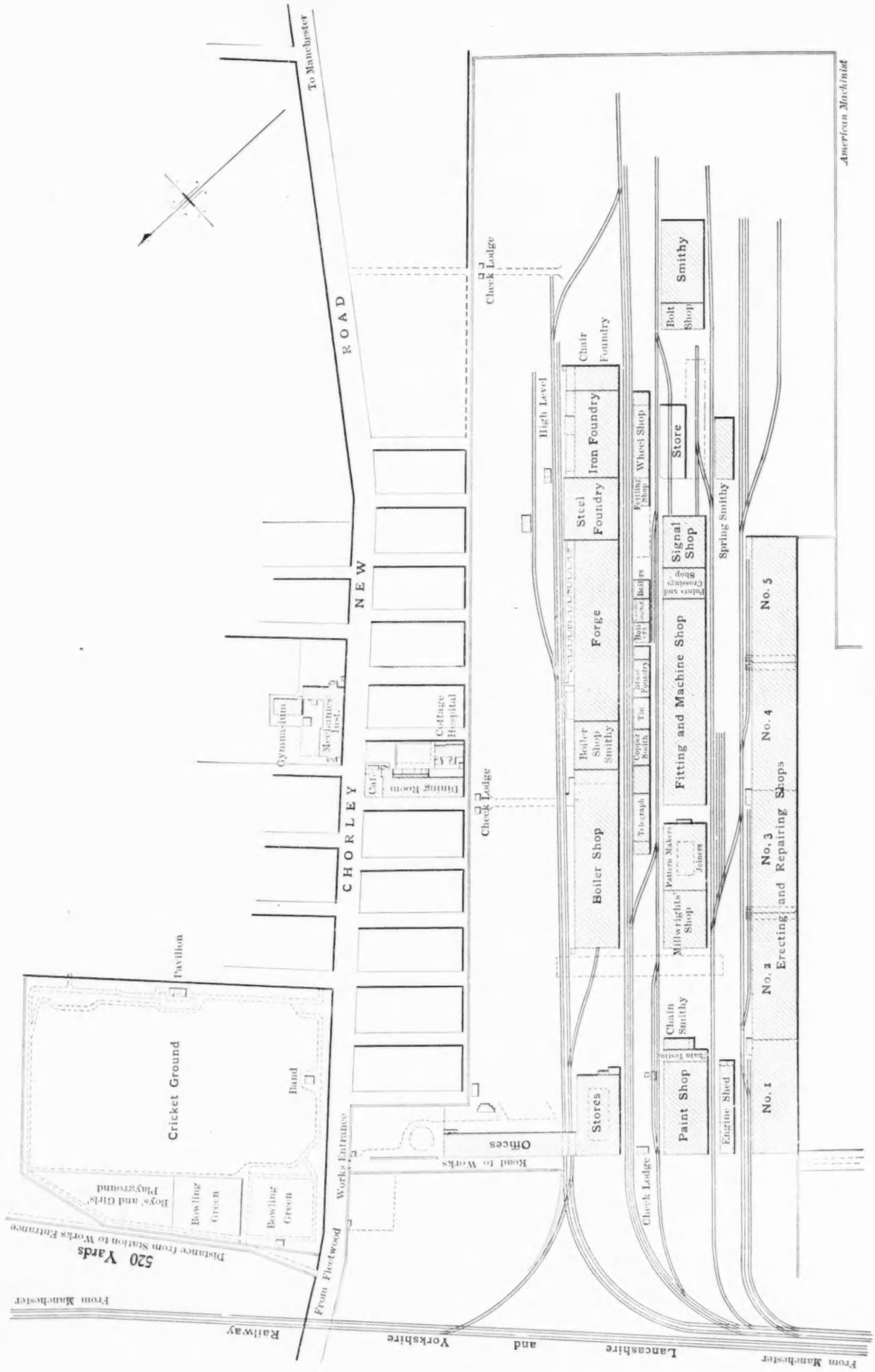


Fig. 1

GROUND PLAN OF SHOPS AND GROUNDS OF THE LANCASHIRE & YORKSHIRE RAILWAY AT HORWICH.

of seating 1,000 people, and in this not only lectures but theatrical and musical entertainments as well are given, there being a large and well-appointed stage. There is also a large library, reading rooms, smoking rooms, metallurgical and other class rooms.

Science and art and commercial and elementary classes are conducted in the institute for the benefit of employés and members of their families, there being chemical and physical laboratories, with all suitable appliances, and regular examinations are held and prizes awarded for special proficiency. Engineering, photographic and shorthand societies and chess and draughts clubs, etc., are affiliated with the Institute, which is governed by a committee of officials of the company and an equal number of employés' representatives, who are elected by ballot each year.

About eleven acres of land were given by the company for a recreation ground, and, at the expense of two of the directors, Messrs. H. Y. Thompson and W. Hinmers, it has been attractively laid out as a recreation, bowling and cricket ground; Mrs. Fielden's generosity also furnishing the well-equipped and constantly used gymnasium which is connected with the Institute. Mr. Thompson, referred to above, donated the hospital, which is a model, and is under the charge of the company's surgeon and a trained nurse. At the time of my visit there was, fortunately, but one patient in it. He had an injured foot, and, in answer to the kindly inquiries of Mr. Aspinall, said that the surgeons were going to operate upon it in a few days, it being then under preparatory treatment.

There is every evidence that these features of industrial life at Horwich are keenly appreciated by most, if not quite all, of the employés of the company, and a visit to the place is most inspiring to one who "has as much interest in the people who go into the shops as in the marvelous products which come out of the shops." The atmosphere which pervades the Horwich shops is a wholesome one, the relations between the employés and the management are of mutual respect and esteem. It is evidently believed that the men employed by the company are something more than mere instruments contributing to the payment of dividends, and they are treated accordingly, with, I am happy to be able to state, most favorable results in every way.

In England, much more than is the case here, railroad companies are in the habit of making practically everything used by them. In a previous article I have referred to the wide variety of things made in the great workshops of the London & Northwestern road at Crewe. The variety of things made here at Horwich is scarcely less astonishing. They commence with the manufacture of their own steel, and make all their own cars and locomotives, signals, switches and telegraph instruments. Elsewhere in this number is a plan of the grounds and cross sections of the various shop buildings. The figures and inscriptions on these will make the arrangement and proportions clear.

The man best qualified to describe the shops is obviously the one who designed and now manages them, and Mr. Aspinall, a short time ago, read a paper before the Institution of Civil Engineers with these shops as his subject. I cannot do better than to quote such parts of this paper as suit my present purpose, and therefore abstract from them as follows: The cross sections of the buildings also formed a part of Mr. Aspinall's paper, but the views made from the photographs (to appear in two succeeding issues) did not, Mr. Aspinall having very kindly sent these to me, together with the drawing of the locomotive cylinders used in the description of the work of finishing these, which process especially interested me.

Mr. Aspinall, in his paper says:

There are three entrances to the works, the "main entrance," leading to the offices and workshops generally; the "central entrance," in close proximity to the men's dining-room and cottage hospital, and the "foundry entrance," which is convenient situated for access to the property built at that end of the works. The works were commenced in 1886, some of the shops were ready and brought into use in 1887, and by the year 1892 they were practically completed. The lighting and ventilation have been carefully studied; the buildings generally are lofty, and operations are exclusively conducted on the ground floor. Gas made at the gasworks is now in use to a great extent both for lighting and manufacturing purposes, but electric light is used in all the large shops where it is more advantageous. A complete telephonic system connects the offices and shops throughout the works. Besides the ordinary 4-foot 8½-inch gage railway connecting the various parts of the works, there is a narrow-gage railway (18 inches) traversing every part of the works, its total length being about 6½ miles. It is worked by small locomotives, which draw trains of

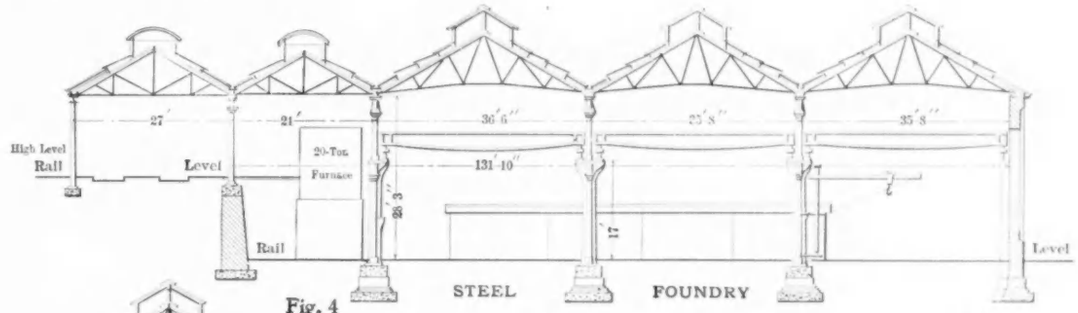
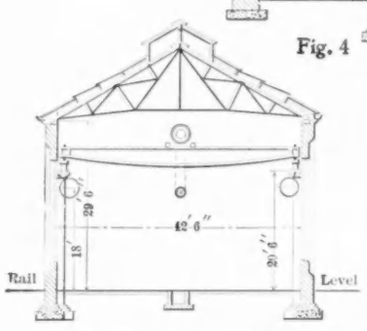
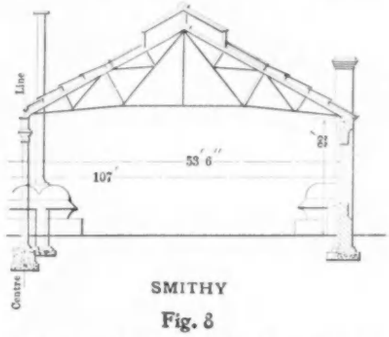


Fig. 4



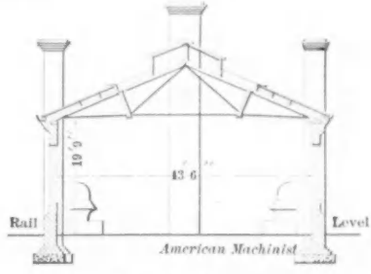
FETTLING SHOP

Fig. 7



SMITHY

Fig. 8



SPRING SMITHY

Fig. 9

HORWICH SHOPS L. & Y. RAILWAY.

strong trolleys conveying materials and finished work between the several parts of the establishment.

On the left of the plan, Fig. 1, are shown the chief mechanical engineer's offices, which cover an area 323 feet long by 58 feet wide. The offices for assistants, the drawing office and the office for accounts, etc., are placed at each side of a wide and well lighted corridor running the whole length and terminating at the gallery of the stores. On the ground floor is a well equipped physical laboratory, and on the top floor, immediately under the water tank which commands the whole works, is a chemical laboratory. One portion of the ground floor is used for a test room, containing a 100-ton testing machine, spring-testing machine, etc., the other portion being used for the works manager's and clerks' and timekeepers' offices. The rail-level at the stores is the common rail-level throughout the works, being 395 feet above Ordnance datum.

The General Stores consist of a two-story building, 198 feet long by 111 feet wide, formed in four bays, a gallery being built round the four sides, leaving a well for light and air in the center. The heavy goods are stored on the ground floor and the light goods on the gallery, access to which for tramway trucks, etc., is afforded by means of a small hydraulic lift, other large stores being hauled up by a hydraulic crane direct from the wagons as they arrive. A small space is set apart for the workmen who require any article from the stores, where they present their respective foreman's ticket.

The Boiler Shop, Fig. 2, is 439 feet long by 111 feet wide, formed in three bays, the first being used for building and repairing boilers, the middle bay being used for miscellaneous work, including tenders and tanks, while the third bay is used exclusively for tools, such as drilling, punching and shearing machines. Over each bay, and running the whole length of the shop, is an overhead traveling crane with a longitudinal traverse of 150 feet per minute, driven by a rope. The small rivet furnaces in this shop are fired by liquid fuel injected by compressed air. At the end of the shop the roof is carried some 16 feet higher for two spans and the full width of the shop, to form a riveting tower. In this space is provided a pair of hydraulic pumps and accumulator, and two fixed hydraulic riveters for boiler work, each having a hydraulic crane for lifting the boilers when riveting. The longest boiler can be riveted in a vertical position. Liquid fuel furnaces are fixed in close proximity to the cranes and riveting machines. Portable hydraulic riveting machines are used in every case where it is possible.

The Boiler Shop Smithy, which is an adjunct to the boiler shop, measuring 120 feet long by 111 feet wide, formed in two bays, is fitted with several smiths' hearths, dome fire, etc. The hydraulic flanging presses are also fixed in this shop for flanging fire-box backs, tube-plates, etc., gas furnaces being built near them for reheating the plates.

The Forge, Fig. 3, 452 feet long by 111 feet wide, formed in two bays, contains the necessary heavy tools for the work required on the railway, the forgings being heated in the gas furnaces. At the back of the forge are the gas producers, and, the natural formation of the ground at this point being 14 feet higher, the producers are charged direct from the top, while the ashes are drawn out at the bottom through a water-seal into tram-wagons on the lower level, no hoisting being required. The scrap is cut up on the high level, and is conveyed through a conveyor into the forge, where it is made up in piles for the furnaces.

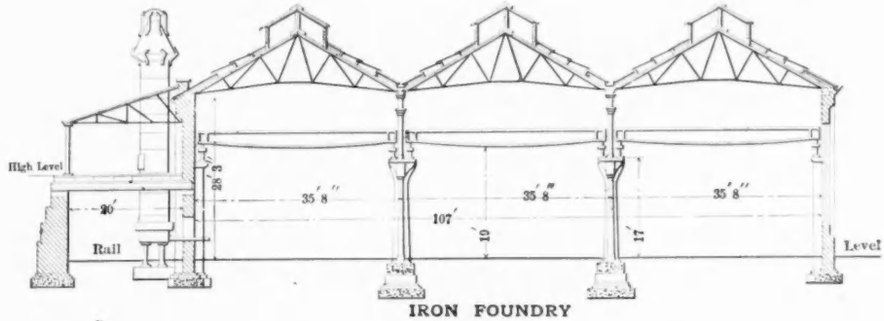
The Steel Foundry, Fig. 4, measuring 150 feet long by 135 feet wide, formed in four bays, contains one 20-ton and two 10-ton Siemens-Martin regenerative melting furnaces, heated by gas from their own series of gas producers. The advantage of the higher ground at the back also proves most economical, as the metal can be run directly into the charge holes without crane power. A high-level tramway has been fixed to carry the steel ladle on small cast iron columns and also one at right-angles to it. The middle bay is provided with an overhead rope driven traveling crane, which travels also the full length of the iron foundry. The core stoves are fixed in the bay nearest to the high level. In the bay where the molding is performed small hydraulic cranes have been fixed against the columns to deal with the molding boxes.

The Iron Foundry, Fig. 5, 212 feet long by 111 feet wide, is also formed in three bays. This shop is used for general castings, not only for locomotive work but for those used in connection with the permanent way, the signaling and the carriage and wagon departments. There are two cupolas at the back of the foundry, the natural formation of the ground at the back proving most advantageous, as it permits the coke and iron to be unloaded and wheeled direct to the charge-holes of the cupolas.

The Chair Foundry, Fig. 6, which is an adjunct to the iron foundry, is 62 feet long by 111 feet wide, in three bays. It is exclusively used for the manufacture of chairs for the permanent-way department, and has two cupolas fixed at the back similar to those of the iron foundry. A feature of this shop is the fettling-bench available for working at each side. After the chairs are cleaned they are placed on the endless chain running in the center of the bench and are conveyed direct to the wagons, which are on a lower level than the common rail level of the works.

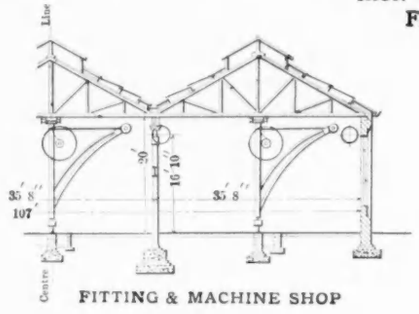
The Fettling Shop, Fig. 7, 90 feet long by 47 feet wide, in one bay, is used for cleaning castings after leaving the foundries, and is also provided with two double annealing furnaces heated by gas.

The Wheel Shop, 165 feet long by 47 feet wide, in one bay, is next to the fettling shop, being separated from it by a partition wall. After the wheels have been fettled they are taken to the lathes to be bored and turned, and are then



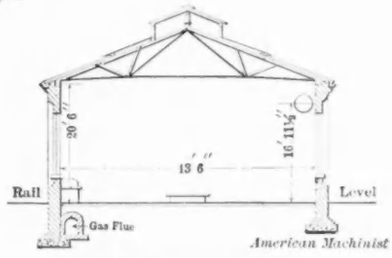
IRON FOUNDRY

Fig. 5



FITTING & MACHINE SHOP

Fig. 10



BRASS FOUNDRY

Fig. 11

HORWICH SHOPS L. & Y. RAILWAY.

loaded direct into the wagons which are run into the shop, the hauling being performed by an overhead rope driven traveling crane running the whole length of the wheel shop, smaller swing cranes being used for the different lathes fixed to the walls. The carriage wheels are also put together in this shop, and a special hydraulic press is provided for forcing the wood blocks between the wheel center and the tyre, as well as another press for forcing the wheels on the axles. Close to the foundry, connected by the 18-inch tramway, a space is allotted, fenced in with wrought iron fencing, for the storage of spare and stock castings.

The Bolt Shop, 60 feet long by 111 feet wide, formed in two bays, contains modern bolt and nut making machines, rivet and nail making machines, and drop stamps for light smithy work.

The Smithy, Fig. 8, is a continuation of the bolt shop, measures 212 feet long by 111 feet wide, and is likewise in two bays. It is a spacious and well-lighted building, containing thirty-three single hearths along the outside walls and eleven double hearths along the middle. Between the hearths are placed at intervals small steam hammers. The blast for the fires is produced by a Root blower, fixed at one corner of the shop.

The Fitting Shop, Fig. 10, 508 feet long by 111 feet wide, is formed in three bays. Along each, traversing the full length of the shop, is a walking crane driven by a rope for the haulage of heavy materials from one machine to another. There are four lines of shafting running down the shop, driven by two large wall engines at one end. A space is allotted to the cylinders which are brought from the foundry to be bored, drilled, studded and finished before being sent on to the erecting shops. A number of milling tools, both horizontal and vertical, are provided, almost all the engine motions being completed by this class of machine; while the usual machine tools, such as drilling and slotting machines and various kinds of lathes, are arranged in their different classes. One portion of the fitting shop is allotted to the brass finishers, and close to the brass finishers' side is the tool room which supplies and repairs all the milling cutters, twist drills, taps and other tools required for the various machines in the fitting shop. At the lower end the setting-out benches are fixed and all the fitters' benches where the small amount of necessary hand work is done. The shop is heated in winter by pipes carried in trenches along the middle of each bay, covered with chequered grating which serves also for tram-lines, grooves being cast in it for this purpose. The shop is lofty and well lighted. The artificial light is afforded by inverted arc-lamps of 50 candle power fixed under large white painted wood disks suspended from the principals, which help to throw the light upon the machines without sensible shadow.

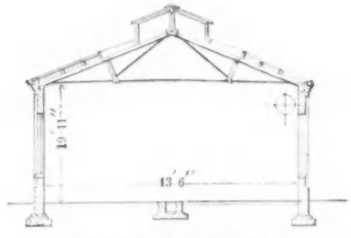
The Telegraph Shop, Fig. 12, 153 feet long by 47 feet wide, in one span, is provided with special tools, lathes, etc., for making and repairing telegraph and block instruments, and other electrical work. A small room is set apart for experimental work and for testing instruments.

The Erecting Shops, Fig. 13, 1,520 feet long by 118 feet wide, are divided into two large bays and one smaller bay in the middle of the shop. The outside bays are used for the repairs and renewals of locomotives, the small middle bay being used for the fitters' benches and for small tools, such as drills, placed in suitable positions along the shops, and for the storage of materials. The erecting shops are divided into Nos. 1, 2, 3, 4, and 5 respectively. No. 1 shop is used for the erecting of new tenders and repairing of existing stock. Of No. 2 shop about one-quarter is taken up for boiler mounting, the boilers being received from the boiler shop are here fitted with tubes and the brass mountings; they are also tested both with water and steam before being sent to the erectors; the other three-fourths of the shop are taken up with general locomotive repairs. Nos. 3 and 4 shops are exclusively used for locomotive repairs. No. 5 shop is mainly used for locomotive repairs, but a small portion is set apart for new work. Each outside bay of each erecting shop is provided with two 30-ton overhead traveling cranes, making twenty in all. Wheel-lathes are provided at various parts of the erecting shops for dealing with the wheels taken from locomotives under repair. A number of portable hydraulic riveters are also provided. Access for locomotives to the center portions of the shops is provided by two traversers.

The Pattern-Makers' and Joiners' Shop, Fig. 14, 164 feet long by 111 feet wide, is divided into three bays, one being exclusively used by the pattern-makers with the drawing stores at one end. The middle bay is fitted with the most modern wood-working machinery, such as circular saws, general joiner, planing and molding machines, etc., and the third bay is divided into two portions, one-half being used by the joiners and the other half by the saddlers for repairing and renewing the belting, etc., of both the indoor and outdoor departments. Along each side bay and across the ends a gallery has been formed for the storage of patterns and other work. A sprinkler arrangement has been fixed in this shop, both on the ground and gallery floors, as a precaution against fire.

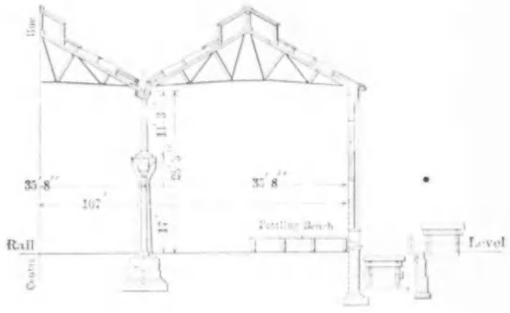
The Engine Shed is provided for stabling the locomotives used about the works. F. J. M.

(Concluded next week.)



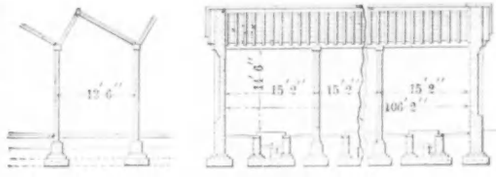
TELEGRAPH SHOP

Fig. 12



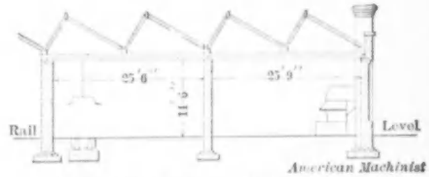
PART CHAIR FOUNDARY

Fig. 6



PAINT SHOP

Fig. 16



CHAIN-TESTING SHOP

CHAIN SMITHY

Fig. 17

HORWICH SHOPS L. & Y. RAILWAY.

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Neither Do We.

At a large electric light station the fireman flooded the boiler, with the result that the automatic governor was wrecked and the eccentric rod bent into a fish-hook. Upon being reprimanded by the chief engineer, this fireman, who has been around steam plants, etc., for ten years, remarked: "Well! I don't see how in h—l the water got into that governor," and the engineer, fearing he might try it again in an endeavor to learn, laid him off indefinitely. Possibly some liquid was the cause of the trouble, and possibly elsewhere than in the governor.

Pump Buckets.

Somewhere about a year ago I wrote something about the use of pump buckets without rings, but with a number of narrow square or rectangular grooves turned in them. This was a style of bucket I had long wished to employ, as I was persuaded that the use of rings was a mistake, and when I inquired from a friend who had some deep well pumps as to the style of bucket he employed he told me that he had ring buckets, but he went on to explain that the buckets were in the well and the rings were hung on a peg in the cupboard. When I could do as I liked with the pumps I designed I resolved to make the buckets as I had always advised, and in a pair of artesian or bore hole pumps of 8 inches diameter I put in buckets of the same length. Except for about ¾ inch at each end, half the surface was cut away in grooves about ⅛ inch deep and ¼ inch wide, and the pumps have worked, of course, with no trouble on the score of bucket jamming. Owing, however, to a faulty weld the bucket rod parted at the top joint, and it became necessary to grapple the rod a few feet down the rising main in order to raise it to the surface. The weight to be lifted was only a few hundred pounds of rods which one man could easily move with a pair of 2-3 sheave blocks. But there was about 1,200 pounds of water to be lifted, and as there was no powerful lifting crab it was necessary to use a screw coupling, and obviously, though the movement was very slow indeed, the leakage of the water past the bucket was very slight. The blocks, with their multiplying power of five and three men, were unequal to putting on a strain and keeping it on, while the water slowly leaked past the bucket and allowed the column of water to rest upon the lower valve. With the screw, a right and left railroad car coupler, we could move slowly and keep the weight of the rods. As soon as the bucket rose clear of the barrel the weight was easily dealt with. The barrel was truly bored by the brass founders, and we turned the buckets simply to an easy close fit, sliding freely with oil. After nearly a year of work the leakage is really of no account. With spring rings in the same time the barrel would have been larger and the rings would have partly expanded, and would grind away both themselves and the buckets until so loose as to be unable to do any more grinding. By that time they would be in a position to try and jam themselves in the barrel, as I have seen them do when worn and able to ride ring upon ring, to the great scoring of the barrels. I should like to know from some American pump maker what is now the approved practice in regard to pump rods in American artesian bore hole pumps and what speeds are allowed.

Here we run slowly; about 20 revolutions per minute, with a stroke of 2 feet, is looked on as fast enough, and I have found no trouble with crank pumps with rods 100 feet in length and the lift in all being something over 75 feet to the surface and 60 feet above the surface, the *something* being the amount by which the water level lowers below its rest level of 75 feet. I have put in pumps to reach 205 feet and to have a 30 inch stroke at 20 revolutions, but reduced to 15 inches and 10 revolutions because of small water yield. For years I used iron rods with the usual scarfed joint covered with a box coupling of gun metal and wheel guides. In the pumps made later, however, I have used square rods of pitch pine and have bolted these between iron straps, still using the box coupling between rod and rod. I hoped in this way to reduce the weight to be balanced, and except for the one faulty weld they have done exceedingly well and have given no trouble. But they were costly to make. So far no pump rods I have seen commend themselves to me as satisfactory in every sense. The box coupling I have found good. It rarely fails. Wheel guides offer far too much risk of pins coming out, and I have concluded that wheel guides are not good. The bucket with rings in it is at the bottom of all the trouble with rods. It is a tight fit in the barrel and has to be forced down by a long, supple, badly supported rod. Need we wonder that pump rods are found buckled? But with a ringless bucket no forcing down is needed. The bucket is heavy, and it may have a piece of heavy rod just above, and will move freely on the down stroke. Why cannot the rest of the rods be a rope of some suitable metal? Only once have I ever used a rope. It was the upper 130 feet contained in a dry well out of a total pump length of about 260 feet. To save weight I used a piece of steel rope, and it acted all right. I should like to know if aluminum rope is made and at what price. I think everyone will agree that the operation of removing a set of pump rods from a bore hole pump will be much simplified when the "rods" can be coiled up in a corner or be otherwise easily disposed of. W. H. Booth.

London.

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The Use of Relief Models.

One of the most strikingly suggestive of the papers presented at the Niagara Falls meeting of the American Society of Mechanical Engineers was that by Prof. R. H. Thurston, entitled "Graphic Diagrams and Glyptic Models." The unfamiliar word in the title (we have found many who did not know off-hand, and few who did know, what "glyptic" means) may have served to frighten away some would-be readers, and as the paper is too long for reproduction in full by the technical journals and also as a whole scarcely designed for popular perusal, being better suited to the closet of the student, it has, perhaps, not received the attention it deserves. The following description of the "glyptic system" and of the construction of a "relief model" taken from the paper will, we have no doubt, be welcomed by our readers.

Cases involving three variables may be represented by the institution of three co-ordinates and by referring to them their curves, or by surfaces in three dimensions, and are illustrated by a "glyptic system," as the writer calls it, which is exhibited best in the various "relief models" so profitably employed in the topographical work of the geodecist and the State Engineer. A glance at the relief model of the Alps, or the great model of the surface of the North American continent, made by the United States Coast Survey, gives a better idea of the topography of the country represented, and permits more satisfactory measurement than can possibly be secured in any less concrete method of description or representation. Relief models have been but rarely employed in other departments of engineering work, but an illustration of their potentialities in new fields may be seen in the relief model employed by the writer to exhibit the variation of the strength of the alloys of copper, tin and zinc, in their infinite binary and ternary combinations. As illustrating the system to which it is desired here to call attention, it will not be out of place to give here an engraving and description of this, so far as the writer is aware, earliest of applications of this method to such purposes as are here considered, although this instance is already tolerably familiar to engineers and physicists generally. The problem proposed for solution was the following:

To determine the properties of all the infinite number of possible combinations of the three metals in triple alloys of copper, zinc and tin.

The properties of the binary combinations of tin and zinc, and those of the compounds of copper with tin and of copper with zinc presented no special difficulties. Their various proportions and the corresponding moduli of strength and elasticity; their densities, resiliences, liability to liquation and unsoundness when cast, and any other valuable or objectional qualities were easily determined in proper sequence, and, the result for each series of alloys being plotted, the law of variation of either property with varying composition, and the maximum or minimum for the whole range and infinite variety of composition, could be readily exhibited, or, if unknown, discovered by the inspection of plain curves thus formed. Such results were, in fact, obtained.

The strongest possible alloy of each pair of elements was thus discovered and announced by the writer, and these re-

searches were fruitful and satisfactory in all ways. It was found that, for the purposes of the constructing engineer, an alloy closely related to "Muntz metal," exhibited the best combination possible of copper and zinc having the best possible combination of strength, ductility and elasticity. The best copper-tin alloy, similarly, is very closely allied to gun bronze; while both alloys are strengthened still further—but at the expense in higher degree of their ductility—by the reduction, by a small amount, of their contents of copper, producing, for example, bell and speculum metals in the case of the copper-tin alloys. These facts are illustrated on the relief model to be now described, and can be seen by studying the contour lines of the two lofty sides of the part richest in copper, which part is seen to contain all the strong alloys.

The principle adopted was the following:

In any triangle, as at *A*, Fig. 1, let fall perpendiculars upon three equal sides

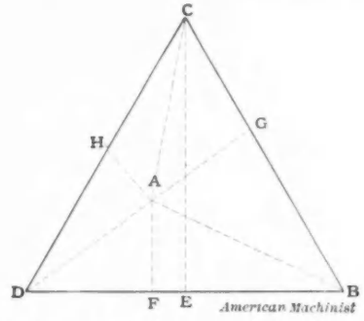

FIG. 1—TERNARY ALLOY DIAGRAM.

The area of the whole triangle *B, C, D,* is measured by the product of the altitude, *CE*, by one-half the base *BD*. Draw lines, *AB, AC, AD*, to the vertices of the triangle, thus forming three smaller triangles, the sum of which equals, in area, the original triangle. We now have: $CE \times \frac{1}{2} BD = AF \times \frac{1}{2} BD + AG \times \frac{1}{2} BC + AH \times \frac{1}{2} CD$; or, the sides of the triangle being equal, $CE \times \frac{1}{2} BD = (AF + AG + AH) \frac{1}{2} BD$. Hence, $AF + AG + AH = CE$.

But the area of the whole triangle may be conceived to represent a ternary alloy composed of the three components in proportions represented by the areas of the three several small triangles, which, together, make up its total area. But these smaller triangles have areas proportional to their altitudes, *AF, AG, AH;* the proportions in which the three metals are combined to form the given triple alloy may, therefore, be measured by the ratio of their representative triangles to the whole triangle in area and in altitude. Dividing the hight of the large triangle into 100 equal parts, the altitudes of the small triangles, measured in the same units, will represent the percentages of the three elements in the given alloy.

Every point in the triangle thus represents some certain ternary alloy; there is no possible alloy which has not its representative point in our triangle. We have before us a field which exactly defines our research, and may attempt its exploration with a clear understanding of what is to be done. Its topography may be studied as systematically and completely as that of any other territory of which the exact boundaries have been determined and marked out.

The results of such an investigation as is finally proposed can now be exhibited by a relief model on which the compositions of all ternary alloys can be represented by the location of corresponding points on a base plane; while the property to be studied as to its method of variation with composition may be represented by ordinates raised upon that plane thus, Fig. 2.

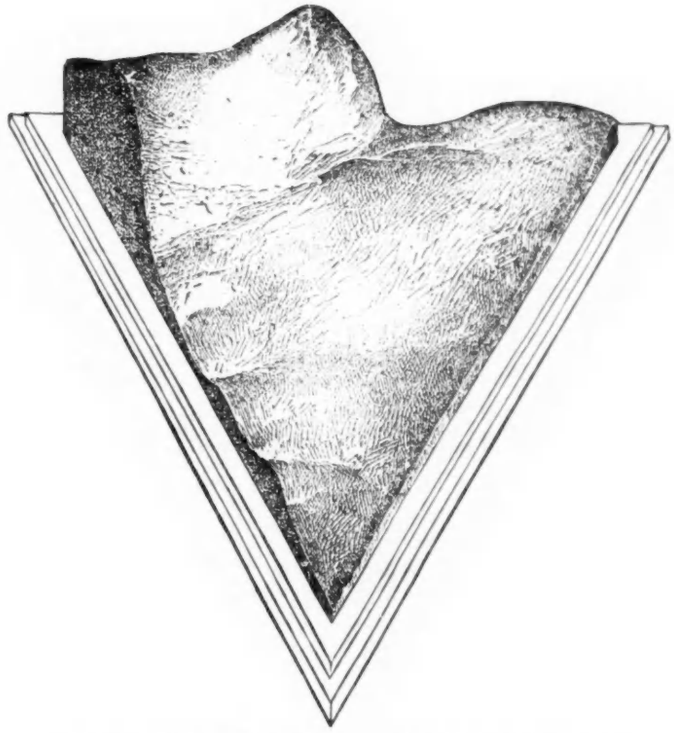

FIG. 2—RELIEF MODEL FOR STRENGTH OF BRONZES.

Lay out a triangle as above described upon a surface of sheet metal. At selected points at which determinations have been made, erect wires of which the lengths have been made carefully proportional to the ordinates of the representative surface at those points, screwing them firmly, or otherwise fixing them, in their places. When all the wires are in place and are found to be of the exact length required, place bits of board along the outside, to form the boundaries of the triangle, and pour in plaster of paris until the wires are all covered. When the plaster has set, remove the boards and carefully cut away the plaster, working carefully down to the tops of the wires, just exposing their points. The surface thus produced is a model of the strength, or other quality represented, of all the alloys. This can be cast in bronze, or, as in the actual case described here, in the alloy of maximum value, and a handsome, durable, and instructive relief model thus formed, the maximum ordinate of which discovers the strongest alloy that can be made of the three elements studied. It was thus that what the writer has called the "maximum alloys" were discovered and fully identified by repeated investigations, among all the infinite possible "kalchoids," or brass-like alloys, obtainable by combining copper, tin and zinc. The strongest copper-tin-zinc alloy exhibits no liquation, its composition being about Cu 0.55, Zn 0.43, Sn 0.2, or neglecting the zinc, substantially that of Muntz metal. The next best alloy was taken as Cu 0.55, Zn 0.445, Sn 0.005; this having less strength but more ductility, the whole field covered by the range, copper 50 to 60 per cent., zinc 48 to 38 per cent., tin 0 to 5 per cent., embraces the most remarkable of these "kalchoids." It includes Tobin's alloy, a chemical combination, having the composition Cu 0.58.22, Zn 0.39.48, Sn 0.02.30. Repeated investigations with carefully selected and pure metals, using phosphor tin to insure soundness by perfect fluxing, identified as "the strongest of the bronzes," Cu 0.57, Zn 0.42, Sn 0.1; while the substitution of 1 per cent. of copper by 1 of tin, Cu 0.56, Zn 0.42, Sn 0.2. Tin should never, probably, for constructive purposes, exceed 2.5 per cent.,

and zinc should be kept inside 43 per cent. This method of investigation thus discovered, as no other method could, the precise character of the whole range of compositions, and revealed as none other could have done the existence and the exact location of the alloy of maximum value. The best alloy, thus discovered, if exactly proportioned, well melted, perfectly fluxed and so formed as to produce sound and pure metallic alloys, with such prompt cooling as shall prevent liquation, is "the strongest bronze that man can make."

It is a close grained alloy, of rich color, fine surface, and takes a good polish. It oxidizes with difficulty, and the surface then takes on a pleasant shade of statuary bronze green. It has considerable hardness, but moderate ductility, though tough and ductile enough for most purposes; it will forge if handled skillfully and carefully, and not too long or too highly heated; has immense strength, and is well adapted for general use as a working quality of bronze. In composition, it is seen to be in brass, with a small dose of tin. The alloy made for purposes demanding toughness as well as strength contains less tin than the above composition, Cu 55, Sn 0.5 Zn 44.5. It has a tenacity of 70,000 pounds per square inch (4,850 kilograms per square centimeter) of original section, and 90,000 pounds (6,450 kilograms) on fractured area, and elongates 47 to 51 per cent., with a reduction to from 0.69 to 0.73 per cent. of its original diameter. This alloy is homogeneous, the fractured surface is in color pinkish yellow, and dotted with minute crystals of alloy produced by cooling too slowly. The shavings produced by the turning tool curl closely, like those of good iron, and are tough and strong. These alloys, including the "Tobin alloy," are good working metals, usually being capable of great improvement by skillful working, either hot or cold, and thus of obtaining a tenacity of over 100,000 pounds per square inch (7,311 kilograms per square centimeter). They are generally of a rich golden or reddish yellow color, and make beautiful castings.

The above description of this application of such graphical and glyptic processes will serve to show how readily it permits the solution of important problems and the discovery of otherwise obscure facts, and often in cases in which probably no other method would answer such purpose, and especially in the detection of maxima and minima in functions of three variables, along which no mathematical law has been detected and for which we must rely entirely on experiment.

The study of the steam engine presents many such problems and the plan has been adopted by the writer in ascertaining steam jacket efficiency in special cases.

An Automatic Hydraulic Friction Clutch.

The accompanying cut, which we re-engrave with slight changes, from "Engineering," will serve to show the construction and operation of the Herschmann friction clutch. Fig. 2 is a small side elevation of the clutch complete. Fig. 1 is an elevation, partly in section, of the open face of the clutch, showing the mechanism, and Fig. 3 is a complete vertical section. This is an automatic hydraulic clutch, oil, however, being employed instead of water, the automatic feature being comprised in the fact that the entire friction is applied by the movement of the two main parts of the clutch relatively to each other. The clutch may be employed in any of the usual ways. One piece may be keyed fast upon the end of

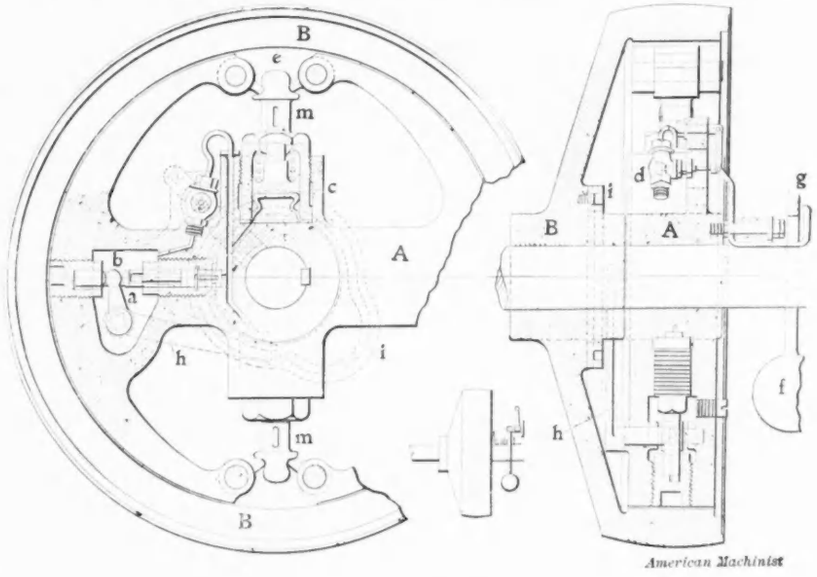

Fig. 1 Fig. 2 Fig. 3

A HYDRAULIC FRICTION CLUTCH.

a driving shaft, and the other piece may be fixed to the end of another shaft, to be driven, or both pieces may be upon the same shaft, the inner piece being keyed to it, and the outer piece, comprising a pulley or gear, either driver or driven, being clamped by the friction device as required.

A is provided with a small plunger oil pump, *a*, Fig. 1, which is operated by the long lever *h*, the outer end of which has a pin working in the cam groove *i* on *B*. Any revolution of *A* or *B* relatively to the other works the pump, drawing oil from reservoir *b* and sending it, through a hole in the ram itself closed by a valve, into a discharge pipe. Two branches from this discharge pipe communicate with opposite leather cups, one shown at *c*, Fig. 1, and a third branch leads back through a spring mounted valve *d*, Fig. 3, to the oil reservoir *b*. If valve *d* is closed the oil is forced under the leather cups, and the plungers *m* are forced outward, and by the toggle arrangement shown they distend the friction arms tightly against the inner friction surface of *B*. When *A* and *B* are thus made to turn together the oil pumping ceases until slipping or release of the friction occurs. To release the clutch at any time it is only necessary to open valve *d* and the friction arms spring back from contact. Valve *d* is controlled by the pendulum weight *f*, Fig. 3. When this is moved away from the pulley it catches the point *g* and pressing it outward opens the valve *d*. The pendulum normally hangs free of both clutch and shaft, so that there is no friction and no side thrust. The pendulum may be arranged to be held back from the valve lever by a cord, which may be led to any part of a factory, and then the cutting of the cord will open the valve and release the clutch. This clutch was designed by Mr. Arthur Herschmann, Erith, England, and is made by Alldays & Onions, Limited, Birmingham. It is patented in the United States.

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Ferdinand W. Peck, Commissioner-General for the Paris Exposition of 1900, sends us a copy of the translation of the Official Rules and Regulations and the Classifications for that exhibition, and says that owing to the limited time still available it is desired that the widest and earliest possible invitation be extended to the manufacturers and producers of this country to participate. Translations referred to above, with blank application forms for space, will be sent by Ferdinand W. Peck, Commissioner-General, Auditorium Building, Chicago.

The Work of the Battleship Oregon.

It had been fully realized by all students of naval affairs that the conflict which has just closed would differ very materially from any naval war in the past. In our civil war machinery played an important part; in some cases, as of the monitors, a part of first importance; but the vessels other than the monitors were still supplied with full sail power. There was little machinery except the main engines, the boilers always used salt water and the coal problem was very simple. In the thirty-three years since the close of that war such vast changes have taken place in the *materiel* of our ships that the whole problem is changed. Our modern ships have no sails, and are wholly dependent on steam power. Instead of one main engine with two cylinders, and a steam pump or two, the modern battleship may have as many as ninety engines with 150 cylinders; salt water is absolutely tabooed, and the coal problem is absolutely vital. In fact, as has been happily phrased, this has been "an engineers' war."

We do not propose at this time to discuss the general features of the war further, but to say something about the remarkable performance of the Oregon, one in which engineers and mechanics all over the world are interested, and in which all our readers, who are Americans as well as engineers and mechanics, must take special pride, because the record reflects so much credit on the American engineers who designed her, the American mechanics who built and equipped her, and the American engineers and mechanics whose ability, faithfulness and devotion to duty carried her successfully through the most remarkable performance ever made by any battleship of any navy of the world.

The Oregon's machinery was designed by Commodore Melville, and, like all his work, was first class in every respect. His designs are not made for a four hour trial only, but to be durable and reliable. The machinery was built by the Union Iron Works, of San Francisco, and its excellence has received such a demonstration as they may have hoped for but never expected. This machinery has been cared for and kept in perfect order by the officers and men under the command of Chief Engineer Robert W. Milligan, to whose experience, vigilance and unremitting attention the great success is due.

Before the actual declaration of war it was very evident to our naval authorities that the theater of the war would be in Cuban waters, and the paper strength of Spain's navy was such as to make it important that all our big fighting ships should be there. The Oregon had just come out of the dock at Bremerton (in Puget Sound), and it was decided to send her clear around to the east coast via the Straits of Magellan.

The journey began at 6:50 A. M., March 6, 1898, and may be considered to have ended when the anchor was let go in Jupiter Inlet, Florida, at 8:30 P. M., May 24. Stops were made at San Francisco, Callao, Port Tamar and Punta Arenas (both in the Straits of Magellan), Rio Janeiro, Bahia, Barbadoes and finally at Jupiter Inlet. With the exception of the one at Port Tamar, which was necessary because the Straits cannot be navigated at night, the stops were all for coal, and there was never a day's delay on account of accident or for repairs. All overhauling and adjustment was made by the engineers' force while coaling was going on; so that, after working frequently day and night while in port, the trip was resumed without rest. In several cases officers and men worked twenty hours on a stretch. They knew the ship was needed, and they were bound to put her through. They had the Jim Bludsoe spirit. When it is remembered that this trip covered the whole width of the tropics in both oceans, and the passage of the Straits in April, the splendid work done is all the more remarkable.

The speed varied at different parts of the run, and averaged over 11 knots. Coming through the broad part of the Straits the ship was driven part of the time well up to trial trip speed.

As a rule, after a trip of even a few thousand miles, it would be considered the proper thing to take a good rest and overhaul the machinery, but on the very next day after arrival, May 25, the Oregon left for Key West, reaching there the next day, and completing a voyage of over 14,500 nautical miles, the longest trip that has ever been made by any naval vessel. Even then there was no rest, and after coaling and a few adjustments the Oregon left on May 29, less than three days after her arrival, for her station on the blockade at Santiago. Even there, as can be readily understood, there was no chance for a thorough overhauling, as it was never known at what moment Cervera's fleet might come out.

We have already spoken of the importance of fresh water, and it is generally known that this was a great difficulty with our ships, as it was practically impossible to get any from shore at Guantanamo, and the distilling ships were not begun until after the war began. The evaporators supplied are not expected to furnish more than enough for ordinary cruising, and in most cases it is probable that salt water had to be used. Fortunately for the Oregon the splendid workmanship put in her machinery originally, and the unremitting care of Chief Milligan had reduced her waste to a minimum, and by great exertion he was able to keep the water in her boilers perfectly fresh. As a brother engineer wrote: "Think of Milligan having the same water in his boilers that he had when leaving 'Frisco, but he hasn't a leaky joint in the ship." It wasn't an easy task, however, as Milligan wrote to a friend: "I fear I am making myself a nuisance to the captain and very disagreeable to my brother officers, as I am continually insisting on the vital importance of fresh water for the boilers, and, indeed, have urged the captain to cut down, if necessary, the allowance of fresh water to that absolutely necessary for drinking and cooking. Thus far the water in the boilers is perfectly fresh, and I mean to keep it so, if it is a possible thing."

The day for which all this hard work had been preliminary finally came—Sunday, July 3—and the results are Milligan's reward and triumph. His constant care and the splendid help of his officers and men had made the Oregon ready for her supreme effort, and she did not fail them. When Cervera's fleet came out she was the farthest away, but she had been kept ready for just this chance, and almost at the signal she went ahead at high speed, and soon was making within a fraction of her trial trip record, when she had a clean bottom, picked coal, a big fresh crew and nearly a thousand tons less displacement. For over an hour she actually averaged just one revolution less than on the trial, and when account is taken of the circumstances just mentioned, it is evident that she really was beating her trial performance and making a greater horsepower.

The result everybody knows. She outspeeded everything else in the fleet, and almost beat the Brooklyn, which was under half power, as Admiral Sampson's report states that her forward engines were uncoupled. She overhauled the Colon, whose captain says that it was the approach of the Oregon with her big guns that made him realize that the fight was hopeless. But for the Oregon's splendid speed the Colon would probably have got away, and this speed was due entirely to Chief Engineer Milligan and the officers and men under him. It seems, indeed, that even more is due to Milligan than is generally known. The fact that the Brooklyn and New York were only able to use half power on account of having the forward engines disconnected shows that all the ships were not kept in instant readiness for full speed, but we have learned from other officers that at Milligan's urgent request all the boilers of the Oregon were kept under steam all the time. His care of them had made them reliable, and his foresight enabled her to get up to full speed almost immediately.

An officer of another ship wrote to a friend: "The Oregon has the finest and best drilled engineers' force I know of. Forced draft is simply play to them. They are ready for anything at any time."

Had the Oregon now been compelled

to lay up for overhauling one would feel it no reflection on her officers, after the wonderful record she had made, but she was still ready for any duty. One of her officers wrote: "If we are given a week for overhauling and adjustment I'd be ready to stake my commission that we could make the return trip to California in as good style as we came round."

The following extracts from official reports show what was thought of the Oregon's performance:

"The Oregon, steaming with amazing speed from the commencement of the action, took first place." (Official report of Rear Admiral W. T. Sampson, U. S. N., upon the battle of July 3, 1898.)

"The fine speed of the Oregon enabled her to take a front position in the chase, and the Cristobal Colon did not give up until the Oregon had thrown a 13-inch shell beyond her. This performance adds to the already brilliant record of this fine battleship, and speaks highly of the skill and care with which her admirable efficiency has been maintained during a service unprecedented in the history of vessels of her class." (Same.)

"The Oregon, having proved vastly faster than the other battleships * * * continued westward in pursuit of the Colon." (Official report of Commodore W. S. Schley, U. S. N., upon the battle of July 3, 1898.)

"I cannot close this report without mentioning in high terms of praise the splendid conduct and support of Captain C. E. Clark, of the Oregon. Her speed was wonderful and her accurate fire splendidly destructive." (Same.)

"The two remaining vessels were now some distance ahead, but our speed had increased to 16 knots, and our fire * * * soon sent * * * the Vizcaya to the shore in flames." (Official report of Captain C. E. Clark, U. S. N., commanding the Oregon, upon the battle of July 3, 1898.)

"As these vessels (the Spanish) were so much more heavily armored than the Brooklyn they might have concentrated upon and overpowered her, and consequently I am persuaded that but for the way her officers and the men of the Oregon steamed and steered the ship and fought and supplied her batteries, the Colon and perhaps the Vizcaya would have escaped." (Same.)

"The Oregon was keeping up a steady fire and was coming up in the most glorious and gallant style, outstripping all others. It was an inspiriting sight to see this battleship, with a large white wave before her, and her smokestacks belching forth continued puffs from her forced draft. We were making 14 knots at the time, and the Oregon came up off our starboard quarter at about 600 hundred yards and maintained her position, though we soon after increased our speed to 15 knots, and just before the Colon surrendered were making nearly 16." (Official report of Captain F. A. Cook, U. S. N., commanding the Brooklyn, upon the battle of July 3, 1898.)

Too often the credit for their work in fast steaming is not given the engineers, generally through simple oversight; but it is extremely gratifying to be able to say that throughout the entire fleet at Santiago there was entire agreement and enthusiasm in praising Milligan and his men for their phenomenal work. From Admiral Sampson down, officers of every corps have joined in commending him, and the President has advanced him a grade in token of appreciation. But an even higher reward than this is the universal commendation which his work has received from the mechanical world, whose members know just what such deeds mean, and that for years to come the record of the Oregon will be *the* record.

As the responsible head of his department, we have given Chief Engineer Milligan the credit for its good work, but we do not forget that without zealous and cheerful assistance from officers and men he could not have accomplished such results. The officers who made the trip from the Pacific and their stations during the action at Santiago were:

Chief Engineer R. W. Milligan, in charge of machinery.

Passed Assistant Engineer C. N. Offley, starboard engine-room.

Assistant Engineer J. M. Reeves, port engine-room.

Assistant Engineer F. Lyons, in charge of fire-rooms.

Naval Cadet H. N. Jenson, after hydraulic pump-room.

Naval Cadet W. D. Leahy, forward hydraulic pump-room.

Assistant Engineer T. C. Dunlap (volunteer) joined the ship at Santiago, before the battle, and was stationed as an assistant in the starboard engine-room.

The number of enlisted men in the engineer department at the time of the action was 114.

Chief Engineer Milligan was born in Philadelphia, April 6, 1843. He was appointed third assistant engineer May 3, 1863, and served on the Mackinaw and Powhattan during the civil war. He was promoted to be a second assistant engineer July 25, 1866, and served on the Swatara until 1869. He was at the Naval Academy from 1870 to 1873, was promoted to first assistant engineer in 1874, and served on the Monongahela, Brooklyn and Bache. He was at the Naval Academy again from 1879 to 1882, then on the Tennessee until 1885, and then became an instructor at the Naval Academy for the four years ending with 1889. He was on the Ranger in the North Pacific for a year, was for a time at the Mare Island Navy Yard, was appointed chief engineer May 16, 1892, and was a member of the board of inspection and survey for three years, and was then appointed chief engineer of the Oregon.

One curious thing about Chief Engineer Milligan's record is that, in spite of his numerous cruises at sea, he has never been clear across either the Atlantic or Pacific ocean, although he has been the whole length from Cape Horn north in both of them repeatedly. Chief Engineer Milligan is a very popular man among his brother officers, and has always borne a high reputation for ability and devotion to duty, but of course this last experience is the culminating point of his career.

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In the Engine Room of the Texas.

Our readers will welcome the following letter by Passed Assistant Engineer Kenneth McAlpine, of the Texas, which we reproduce from the columns of the New York "Evening Sun." It is excellent material for the history of the naval engineer in modern and victorious warfare, and all the better that it is written by an actual and responsible participant.

The task of operating the many mechanical devices on board a modern warship in active service requires the most careful supervision of his subordinates by the engineer in charge. The least mistake in interpreting an order may involve the ship in irretrievable disaster. To reduce the chances of misunderstandings to a minimum the orders governing the movements of the engineers when on duty have been made as simple as possible. Orders are early passed to get steam up in all boilers, but there is not much thought usually given to the detail work involved. The furnaces at both ends of the three boilers on the Texas are prepared for lighting by covering the back bars of the grate with coal and starting a light wood fire in front.

This in due time ignites the coal, and the fires are gradually built up to a steaming level. Usually the hydrokmeters are started, or, in their absence, the cold water is pumped from the bottom to the top of the boilers, so as to promote the circulation of the water and the formation of steam.

Ordinarily about twelve hours are required from the time fires are started until the ship is ready to get under way, though in time of need this can be reduced to about five or six hours.

Working in a crowded harbor, such as was Guantanamo Bay when we were last there, entails much trouble and careful supervision on the part of the engineer of the watch. The ships were so thickly scattered about that the engines were incessantly in operation, at varying speeds, from full speed ahead to full speed astern. Meanwhile the fires were burning brightly, and steam could only

be controlled by the use of the damper doors and the bleeder valve.

In the old days, when a ship came to anchor it was a usual and customary thing to see the safety valves lifted, accompanied by a dense cloud of steam and a corresponding noise on deck. In the new navy, however, the safety valve plays but a small part, and under ordinary circumstances is never used. I recall but one case in which it was required while the Texas was in Cuban waters, and that was upon the day of our engagement with Cervera's fleet, when the valves promptly popped at 157 pounds pressure, the safety limit. Blockading duty, at the best, is hard work for all concerned, and in the fire rooms entails more watchfulness and care than a regular steaming watch. With orders to be ready to go ahead at full speed on a moment's notice, the utmost care must be exercised, the fires watched and the engines occasionally turned to free them from water. The great trouble, however, we found was in regulating the fires, which became deadened from the constant use of the ash-pan doors, thus checking the draught and rendering the fires sluggish.

On July 3, when the Spanish fleet sailed out from Santiago harbor and the "general alarm" was sounded, we below in the fire rooms reaped the benefit of our care and were at once ready for a full-speed trial of our engines. The fire rooms were closed up, the forced draught blowers started, the engine room battle hatches shut down, and all hands below virtually sealed up in their air-tight coffin, awaiting, it might be, a watery grave.

The men behaved remarkably well, and one would have supposed that we were off on a picnic party instead of being in the midst of a fight. When the ship, at about 10:15 A. M., was struck by a 6-inch shell, which exploded in the forced draught ventilating duct, on the starboard side, knocked a big hole in the base of the smoke pipe and filled the middle fire rooms full of smoke and gas, there was not the slightest sign of excitement, or any apparent desire on the part of the men to leave their station. I heard a dull concussion, and went into the fire rooms, where everyone seemed to be happy except a few who complained that the Spaniards had fired some Chinese stink pots into us. One of my brother officers, who had been standing in front of the connection doors, appeared with his face as black as ebony, and I saw a poor coal passer nursing his head, which had been injured by a shutter falling on it.

I was much pleased to note that many of our men voluntarily remained in the fire rooms, saying that they did not want to leave there until the Colon was caught. And I could not help laughing when an old veteran of our civil war remarked to me that he was a poor man, but he would rather give $50 "out of his clothes" than see the Cristobal Colon get away.

During the engagement with Cervera's fleet the temperatures below were something terrible. In the lower engine rooms, in front of the ventilating blowers, it was about 136 degrees, and in the upper ones 190 degrees. Of course, no man could have lived in the latter temperature, but fortunately it was only necessary for a man to be in it for a few minutes every half hour or so. The only method of ventilating the engine room was by a blowing engine, which drew cold air down one air duct and allowed the hot air to escape through another, both being about three feet by two feet. I have seen in the papers that Chaplain Jones tells a yarn about standing a watch in the engine and fire rooms with an officer on board this vessel.

Should he really desire to get some idea of the terrific heat down below, it is a great pity his watch should not have been in the fire rooms on July 3, when the temperature above the boilers ran over 200 degrees.

It is rather amusing to see in some of our illustrated, as well as daily papers, cuts of "the men in front of the fires," where they are represented as being stripped to the waist. In fact, no such thing has ever existed in our modern navy, as the men know too well that such attire would simply invite a plentiful crop of blisters. Woolen wear is always much in evidence, even under the hottest temperature.

When we were struck by the 6-inch shell in our smoke pipe on July 3, quite a puzzling question was for some time presented to us. There was a strong and growing smell of burning rags, and the officer of the deck was notified through the speaking tube of its existence. He failed to find its source, however.

The fire was finally located from the appearance of burning socks and portions of underwear, which were sucked down through the ventilating ducts, whirled into a blaze by the blowers, and finally projected into the fire rooms. We then remembered that our men had been permitted to hang their wash-clothes in the ventilating ducts. The clothes had been fired by the explosion of the shell and had drifted down into the blower engines themselves. The fire was soon extinguished, and the atmosphere became more endurable.

During the chase of the Cristobal Colon the engines worked well, and after the priming in the boilers had been checked and everything had settled down to working conditions, the Texas was making, and could have maintained, a speed of 16 knots, and an average of 115 revolutions, only 13 below what she made on her official trial trip, when her bottom was clean and she was not handicapped by an abnormal growth of barnacles and weeds. We were always steadily gaining upon the Colon, running at least one knot an hour faster.

The peace complement of this vessel is ninety-seven men in the engineers' department, which was to have been increased to 154 during times of war. The war is over, but the men have never materialized.

When the general alarm is sounded the officers of the engineer division repair to their stations below, the chief engineer in general charge, the first assistant in charge of starboard engine rooms and assisting the chief engineer, the second assistant in charge of port engine room, the third in charge of hydraulic machinery, and two assistants in fire rooms, one on each side, and one in charge of hose connections in the upper central passage. Each officer's duties are so clearly laid down and specified that no chance of mistake is left open.

Of course, when going into action men are always stationed to close off all steam and exhaust pipe connections which may run above the protective deck, thus minimizing any danger from scalding men at the 6-inch and rapid-fire guns on the gun deck.

KENNETH MCALPINE,
P. A. Engineer, U. S. N.

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International Trade Opportunities.

BY H. J. GEISSEL.

SIAM.

The Kingdom of Siam is making rapid progress in the development of its industries. The country, and especially the capital, Bangkok, is crowded with extensive rice and teakwood sawmills. Siam is one of the largest rice-producing countries in the world. In 1897 the exports of rice amounted to a value of about $12,000,000. All machinery used in the rice and sawmills is either of British or German origin. The importation of machinery is increasing from year to year. Machine tools are also being imported from Great Britain and Germany. The leading importers are the Bangkok Dock Company, Limited, Bangkok, and the Menam Engine Works, Limited, Bangkok. The Bangkok Dock Company has extensive shipbuilding yards, machine shops and foundries, and is building quite a large number of vessels for traffic on the River Menam. Railways, electric plants, gold mines, etc., are being extended, and our manufacturers should exert themselves to gain a foothold in this valuable East Asiatic market.

SIBERIA.

The city of Vladivostock, on the Pacific, is becoming more and more an important commercial center in the Far East. As the terminus of the Great Siberian Railway, and the principal Rus-

sian port on the Pacific, it offers the best opportunities as a distributing point for imported goods. A few weeks ago the Russian Government appropriated a large amount for the construction of an extensive shipbuilding works at Vladivostock, where it is intended to build especially torpedo boats for the Russian navy. At present almost the whole trade at Vladivostock is controlled by German merchants, who have their own steamers running on the Amour River and are doing a large trade. Kunst & Albers, and the firm of Dickmann & Co. are leading importers of machinery and tools. In 1896 our exports of machinery to Siberia amounted to a value of $103,237, and fell off to $18,553. Saws and tools were exported from the United States to Siberia valued at $11,376 in 1896, and $25,228 in 1897, while the exports of boilers amounted to $17,600 in 1896 and to $6,043 in 1897. There is every reason to suppose that by energetic efforts our trade in machinery and tools could largely be increased.

INDIA.

Prominent among the many markets which have to a large extent been neglected by American manufacturers is British India. In 1896 Great Britain exported to India:

Locomotives	$928,600
Agricultural machinery	234,700
Agricultural implements	62,100
Mining machinery	351,200
Sewing machines	126,800
Textile machinery	6,221,700
Other machinery	3,225,200

while the total exports of machinery from the United States to India (including all the above items) amounted to a value of $100,856 in 1897, as against $93,381 in 1896. There are, however, no discriminating duties against us; since October, 1897, there is direct steamship communication between New York and British India, and there is no reason whatever why we should not claim a fair share of this yearly increasing trade.

ITALY.

The development of the Italian machine industry is making rapid progress. The shipbuilding works of Ansaldo & Cia., at Sampierdarena and Sestri Ponente (both places near Genoa), are reported to be crowded with orders. Breda & Co., of Milan, have received a few weeks ago an order for 22 heavy locomotives from a Danish railway company. A leading Italian machine builder made, some time ago, the statement, that, in spite of the high prices, American machine tools find a ready sale in the kingdom, and that their importation could easily and largely be increased if proper efforts were made by American manufacturers. If it is remembered that Italy imports yearly machines and tools to the amount of about $6,000,000, it will be understood that that country should offer a valuable outlet for our manufacturers. At present our share in this trade is very unimportant. The cities of Genoa, Turin and Milan are the principal centers of the Italian machine industry. Manufacturers of textile machinery should pay special attention to the Italian market.

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Letters from Practical Men.

Professor Sweet's Improved Lathe Footstock.

Editor American Machinist:

I have read with interest Prof. Sweet's account of his improved footstock for his lathe, and there are some points about it which it seems to me are particularly admirable and which lathesmen ought to be thankful to him for calling attention to. Especially, I think it ought to be a criminal offense for a man to build a lathe without any means for controlling the position of the clamp beneath the footstock. We all know that this clamp as ordinarily constructed is a source of annoyance and a cause of profanity. It swings freely upon its bolt or bolts and invariably when the footstock is moved quickly it drags behind, tightens and has to be further loosened or the footstock moved in the opposite direction to allow it to swing free again. Prof. Sweet's lugs prevent this and enable the footstock to move freely whenever the eccentric is loosened. A couple of pins driven into the footstock and entering holes drilled for them in the clamp, would obviously answer the same purpose, and where it is possible to put them in it will, I venture to say, usually be found a paying operation.

I like also the idea of placing the eccentric shaft longitudinally in the footstock so that the tightening lever moves forward and backward instead of in a plane parallel with the shears, as is often the case. The arrangement shown by Prof. Sweet is much more convenient, and also gives opportunity for placing the clamp as far forward as possible, where, of course, it ought to be.

As to Prof. Sweet's projecting barrel or nozzle on the footstock, it seems to me there is something to be said on both sides of that question. Where work is very short, that is, not to exceed a length equal to the width of the bridge of the carriage, then this projecting barrel undoubtedly helps to support the spindle and is useful, but on most long work it is not necessary to run a cut from the beginning close up to the dog. If a plain shaft is to be turned, it is usually best to terminate each cut at the center of its length for various reasons well understood by lathesmen, among others being that it imposes an equal amount of wear upon the centers in the work and better prepares them for remaining true under the finishing cut, and confines the wear of the shears to a portion of the lathe bed, which usually does not get its fair share of use. Then, too, in most long work there are more or less shoulders which prevent taking a continuous cut from one end to the other, and in all work of this character it is possible, and in fact is, the custom of good men to have the tail spindle project as little as possible, and place the tool post as near the right hand side of the carriage as possible, thus avoiding the unnecessary overhang of spindle.

The scheme reminds me in some way of what Chordal said some years ago about the twist drill, when he said, as I remember it, that, "whether it is an increased twist or a decreased twist depends upon which end of the drill you begin to talk about first." So it is with this footstock; whether it is a projecting barrel or an undercut footstock depends upon whether we commence by considering the length of the lathe bed or the length of work that the lathe will take between centers, for it is obvious that with a given length of bed this lathe with the footstock with projecting barrel and with the same length of bearing upon the shears, has its capacity to take long work reduced by the amount of projection.

Then regarding the four-armed pilot wheel on the footstock spindle. I must say that I do not fancy that very much. It is all right for a chucking lathe, where the footstock spindle must be fed by hand a great deal, and with considerable force, and, in fact, such wheels have been used on chucking lathes for twenty-five years, to my knowledge, and I do not know how much longer, but for an engine lathe, it seems to me that every hand wheel should be so made that some portion of it will always be found in precisely the same position with regard to the other portions of the lathe and the work. With the wheel shown by Prof. Sweet, a lathesman would necessarily make some false moves in reaching for the wheel while watching his work, and false moves, and the causes of them, are, of course, always to be avoided. A thousand cases arise in which a lathesman wishes to very quickly move this wheel, and he wants to do it without being under the necessity of looking at it to see where it is or where his hand must go to reach it, and this condition is fulfilled only by a wheel with a circular rim. It may have a handle in it, and, in fact, should have; but it should by all means nevertheless be perfectly balanced, as, in fact, I believe all hand wheels about a lathe should be.

S. T. FREELAND.

How Does That Reducing Gear Work?

Editor American Machinist:

That reducing gear shown in your issue of of August 4 is hardly the kind of thing to spring upon us in the dog days. Things of that kind when they get hold of a fellow don't let go very easy. At least they don't give me much peace until I get some kind of a solution. Though the solution when found may not be the correct one, it is quieting all the same. As Mr. Vose gives the numbers of teeth in the gears and does not give the numbers of revolutions at either end, at the same time telling us that a model of the device went the rounds of the technical institutions without yet getting any independent solution, he kind of challenges us to put ourselves in a position to feel sorry for those unfortunate British youth.

I used a sketch like this which I send you in my struggle with the gearing, and by its aid I will be able to show how I got along with it. As I understand the

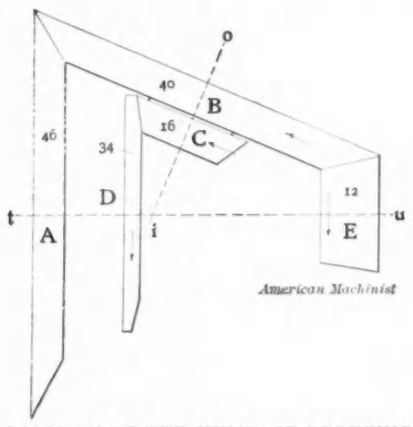

DIAGRAM OF THE HUMPAGE REDUCING GEAR.

thing, gear A is fixed, pinion E is the driver, and gears B and C form a compound gear turning together on a stud, the stud and compound gear being free to turn around the central axis. D of course is the driven gear. Now, I tackled the thing in the middle of the train, turning the stud, in my mind, toward me until it had made a complete revolution around the shaft, gears B and C of course turning in the direction of the arrows, E also turning forward or downward in the direction of its arrow. If the stud $i\ o$ was stationary and the gears A and E turned, B also turning, they would both have the same tooth velocity, and if A made a complete revolution, or passed 46 teeth, E also would pass 46 teeth or make 3 10-12 revolutions. Supposing the stud $i\ o$ to revolve around the axis $t\ u$ with the gear B fixed upon it and not turning, B being in mesh with E, but assumed for the time to be not in mesh with A, then this complete revolution of $i\ o$, carrying the gear B, would cause a complete revolution of E also. In the actual operation of the gears the total movement of E is the sum of these two movements; that is, it moves 46 teeth, or 3 10-12 turns, on account of the rotation of B upon the stud $i\ o$, and it moves 12 teeth additional on account of the revolution of B around the axis $t\ u$, or the total revolution of E for one revolution of $i\ o$ around $t\ u$ will be 4 10-12 turns.

For one revolution of $i\ o$ around $t\ u$ the gear B must pass 46 teeth, or make 46-40 = 1 6-40 turns upon its stud $i\ o$, gear C, of course, turning the same. C being in mesh with D it would, if not allowed to turn upon $i\ o$, carry D around one complete revolution, or 34 teeth, in the direction of its arrow as $i\ o$ made its revolution around $t\ u$. But while C is carried around by the stud $i\ o$ it also, as we have seen, makes 1 6-40 turns upon $i\ o$, this revolution being in the direction that would tend to turn D backward. Now $16 \times 1\ 6\text{-}40 = 18\ 16\text{-}40 = 18.4$ teeth. The forward revolution of D, therefore, would be only $34 - 18.4 = 15.6$ teeth, or $15.6 \div 34 = .458$ of a revolution. As to produce this movement E has made 4 10-12 or 4 5-6, revolutions, the relative speeds of D and E will be: .458 : 4 5-6 :: 1 : 10.55 revolutions.

If we make a little change in each of the gears we get quite a different result, as Mr. Vose told us. Say that we take the gears like this, using numbers that will make easy figuring: A-48, B-32, C-20, D-32 and E-12 as before. Then E will make five revolutions to one revolution of the stud $i\ o$ around $t\ u$, and B and C would make 1½ turns on $i\ o$ at the same time. As 1½ turns of C would give 30 teeth backward, the movement of D would be $32 - 30 = 2$ teeth, or 1-16 of a revolution, and the relative movement of D and E would be: 1-16 : 5 :: 1 : 80.

If the tooth ratio of D to C is the same as that of A to B the gear D will not turn, no matter what number of teeth E may have. A difference of a single tooth will then produce a very minute movement, and this movement of the driven gear may be in either direction, relatively to the driver, accordingly as the difference is one way or the other. If A has 48 teeth; B, 47; D, 47; C, 46, and E, 12, the ratio of D to E will be 1 to 11,030. Here it is evident that a slight change, as, for instance, adding one tooth to C, would make D run the other way.

It is not a difficult matter to make a formula for this thing. We can use the corresponding small letters for the numbers of teeth in the several gears designated by capitals, a for the number of teeth in A, b for B, and so on, and then we have for the number of revolutions n of D to one revolution of E:

$$n = \left(\frac{a}{e} + 1\right) \times \left(d + (d - \frac{ac}{b})\right)$$

This gearing seems to be interesting and valuable for the especial reason that it avoids the abnormal stress and wear usually associated with differential gearing, as particularly pointed out by Mr. George B. Grant in the columns of the "American Machinist" a year or two ago.

MORRIS FULTON.

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Drill Sockets.

Editor American Machinist:

I have read with interest the articles in your excellent paper, July 28 and August 4, 1898, referring to drill sockets and taper shank drills. I want to say first that when the sockets and taper shanks of drills are both the same taper they will drive without slipping, even when the drill has no tang. This has been tested and found to be so. The drill press will be stopped before the drill slips. I am not suggesting that it will be wise to have drills made so, however. It is very important to have sockets that have holes correctly made, and that the shank of the drill should be made with the same degree of care. I feel quite sure that when heavy strains come on the tongues of drills it is when the tapers do not fit.

I can hardly make up my mind that "Mr. Wright" is improving matters by making the tongue of drill enter the slot in socket further than the standard now on the market calls for. It seems to me he will not be any better off, and I think, Mr. Editor, you will agree with me when I say he will twist the tongues just as readily after he adds a few sixteenths to the length as before.

I notice Mr. Wright has made a set of plug gages, Nos. 1, 2, 3, 4 and 5, and that only 18½ hours' time was required to make these five standards. I have worked for some twenty-six years on fine tools and many of these so-called for precision, but this 18½ hours on five standards beats any record I have any knowledge of, and I am sure if "Bill" and "Johnny" made these really standard they did something remarkable.

My advice to those in want of either taper or straight standards is to have them made by the manufacturer of standards. The "Morse Company" no doubt have the original taper standards and can send out duplicates. In getting one of these taper standards the question of importance is whether it is an exact duplicate. Now, if you try to find this out by the common method of measuring and comparing, you may not agree with the figures you find in the "Morse" catalog, or by their blue prints.

I doubt very much if any set of men can get the same reading from the same taper standard. I think it would be interesting if "Mr. Wright" was to send his 18½ hours' standards to the "Morse Company" and have them compared with the originals and let us know through your paper how they compared.

I can't help but think if Mr. Wright was to visit the "Morse Company" and was to see their plant for making sockets he would realize that making drill sockets in an ordinary tool room is a job to be dreaded.

I note that "Mr. Wright" had made in his tool room eight sleeves, Nos. 2 to 3, and he fully describes the operation. His method of truing is not reliable, unless he has a test bar, say, some 14 inches long, to test the sleeve before the last cut is taken. As he fails to tell us about this test bar, we feel he has not used it. Therefore, I want to call your attention to the fact that when the taper was turned he tells us it was done "with a rush." Now, what about those centers? Do you think that after this "rush" Johnny gave the sleeves were true? And, then, just think of the operations of this fellow at the vise with the hammer and drifts.

We are informed that these sleeves only cost $1.85 each. The regular sleeves on the market are listed $2.40, and no doubt your dealer will give you at least 40 off, making the cost for a first-class sleeve $1.44 net, and unless the tool steel sleeve is hardened and ground I doubt if it will last any longer than the market sleeve.

I have learned that the makers of first-class sockets do not make them from common machinery steel, but use a a higher grade, or a special steel for this purpose. DRILLMAN.

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More Wide Cuts.

Editor American Machinist:

The several recent articles in the "American Machinist" on wide cuts taken on machine tools present points well taken, and as Mr. Chappell considers that he should have some of the credit for the cuts taken, as illustrated by Mr. Bryan, it may not be out of place to mention that several years ago I installed two "Gisholt" turret lathes in the shops of the Hercules Iron Works Company, and on one of the machines which swings 21 inches finished some steel castings, taking a cut 4 inches wide. As this was before Mr. Chappell took charge at these works, it may or may not have been instrumental in leading up to the 12-inch cut spoken of.

Regarding these 12-inch cuts they apparently were taken on castings weighing several thousand pounds. As not all shops have to deal with such large castings, they possibly will not be as generally interesting as though these cuts were taken on castings weighing up to, say, two or three hundred pounds. I might mention hundreds of up-to-date manufacturers using this wide cut system. Having come in contact with several thousand pieces finished with wide cuts, I will illustrate a few samples.

Fig. 1 shows a conveyer pulley, weighing twelve pounds, finished as indicated. The surface from *A* to *B* was finished with a broad tool, the entire surface being finished at one cut. Fig. 2 shows a steel forging finished all over, all of the facing being done with broad tools. The widest cut taken was one of 4 inches. This piece required great accuracy and high finish. Fig. 3 shows a pulley which is finished all over; in this case the cut, 12 inches wide, being taken on the casting, which weighs 115 pounds.

I agree with Mr. Chappell: all that is necessary is to have the work, the tools and a man to do certain things, and how easy to obtain! Manufacturers of specialties are continually advertising what they can do and sending out experts to make good their assertions. I find there is much to be learned from carefully reading the "American Machinist," the advertising, especially the front page, needing as much attention as the regular reading matter.

GEORGE A. STEINLE.

Madison, Wis.

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In twenty-five years merchant shipping under the German flag has increased twenty fold.

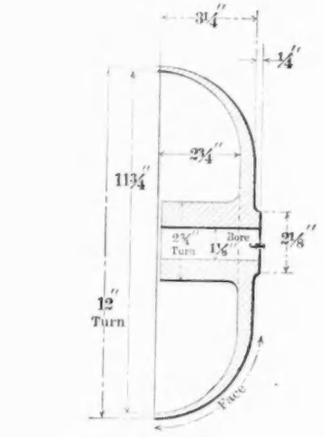

Fig. 1

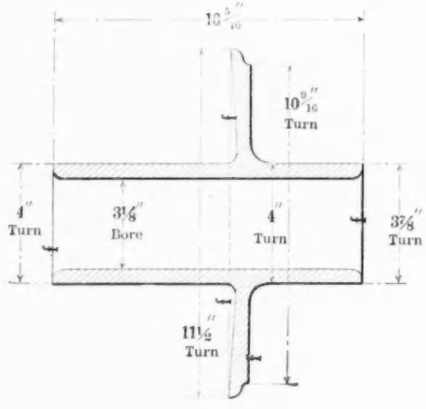

Fig. 2

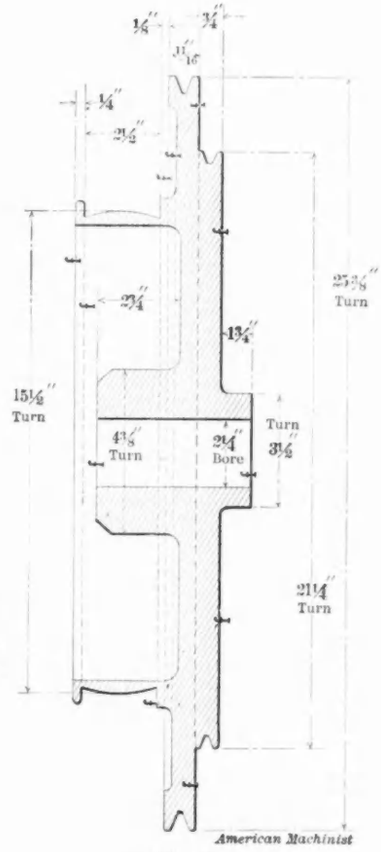

Fig. 3

WORK WITH WIDE CUTS.

Some Gage Suggestions.

Editor American Machinist:

A number of improved drill gages have appeared in the "American Machinist" recently that are evidently very handy, and I would like to suggest to the people interested in the manufacture of drill gages that the back side of the gage of the style numbered from 1 to 60 is a good place to put the sizes of the different holes in thousandths of an inch, something like Fig. 1. It would prove, I know from my own experience, a very handy feature in this gage. Anyone having such a gage can, with a little trouble, wax it and etch the sizes on it.

I have very often, in making forming tools for screw machine work, lathe tools for shaving milling cutters and in working out fly cutters, felt the need of a set of concave and convex half-round gages of such a form as to be used handily in making these tools. I was at one time quite familiar with some A1 microscope makers, and many of their ingenious rigs I have found to be very useful. For turning, grinding and polishing their lenses they made sheet brass gages soldered to a stem with the diameter or radius marked upon them, Fig. 2, and it

has seemed to me that if some of the small tool makers would make sets of them, say, from 1-16 of an inch to 1 inch diameter, or larger, varying by thirty-seconds or sixty-fourths, in the style of Fig. 3, or something better, they would be a salable article. I have made mine, as machinists usually do, by drilling a hole in a bit of sheet steel and filing half of it away, or by turning a disk from rod or sheet metal, as I wanted either concave or convex gages.

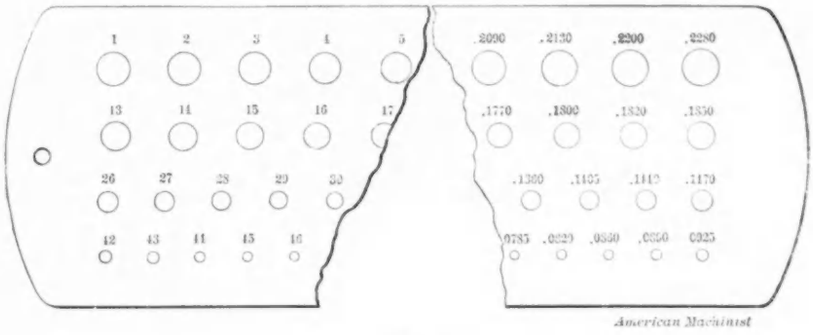

Fig. 1

MARKING BOTH NUMBERS AND DIMENSIONS ON WIRE GAGE.

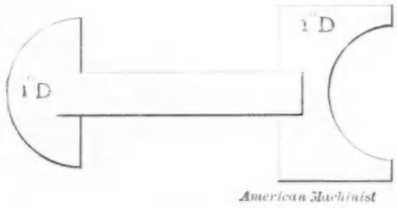

Fig. 2

GAGE FOR MICROSCOPE LENSES.

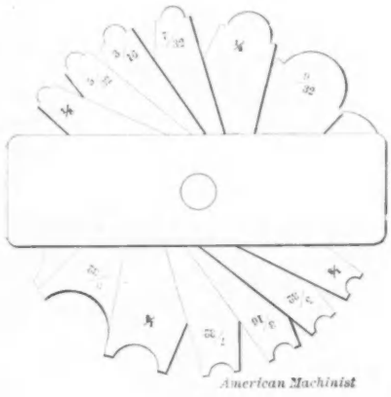

Fig. 3

GAGES FOR SMALL CIRCLES.

Another gage that is very convenient is made in the form of the familiar center gage, Fig. 4, only the angles conform to those of the flat head wood or machine screws. It is a handy gage to make counterbores, or, if occasionally some of the screws must be made in the lathe, to shave up the heads to.

The notch in the ordinary center gage for grinding thread tools to is often too deep, the sides near the V-notch hitting the shank of the thread tool, when it happens to be an inside tool and the hole is small, requiring a fine thread. I use the form of screw pitch gage shown in Fig. 5 to grind and set the tool by. From the collection of pitches in one of these gages one can always be found small enough to clear the tool shank for any but a very unusual job. MACHINIST.

Fig. 4

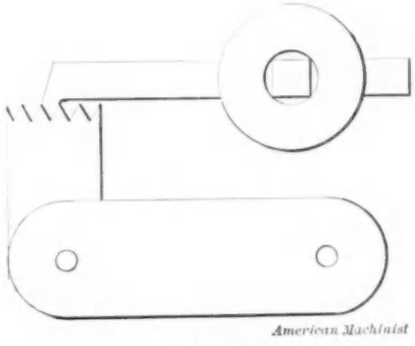

Fig. 5

GAGE FOR WOOD SCREW COUNTERSINKS AND FOR SMALL THREAD TOOLS.

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International Association for Testing Materials.

The first annual meeting of the American Section of the International Association for Testing Materials will be held at the Engineers' Club, 1122 Girard street, Philadelphia, August 27. The following program has been adopted for the afternoon and evening sessions:

AFTERNOON SESSION, 3 P. M.

Reading minutes of meeting of June 16, 1898. Adoption of by-laws. Announcement of appointments. Other business.

EVENING SESSION, 8 P. M.

Discussion—Subject: "The Relation of the International Association to Producers and Consumers," to be opened by Dr. Charles B. Dudley and Mr. William R. Webster.

Discussion—Subject: "In What Manner Will the Adoption of Standard Specifications Improve Industrial Methods and Processes," to be opened by Prof. Rolla C. Carpenter and Mr. Gus. C. Henning.

The officers of the American Section are: Chairman, Prof. Mansfield Merriman; vice-chairman, Prof. Henry M. Howe; secretary, Richard L. Humphrey, Testing Laboratory, City Hall, Philadelphia.

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The Reversed Relations of Exports and Imports of Iron and Steel.

Figures recently compiled by the United States Treasury Bureau of Statistics speak for themselves as to the growth and tendency of our iron and steel industries. The following relate to products of iron and steel alone:

	Imports.	Exports.
1880.....	$71,266,699	$14,716,524
1890.....	41,679,501	25,542,208
1896.....	25,338,103	41,160,877
1897.....	16,094,557	57,497,872
1898.....	12,615,913	70,367,527

In the first of these years the ratio of exports to imports was .2064, while in the present year it is 5.579, and the ratio of these is 1 to 27.

The figures given out are also of interest when examined in detail, only a few of course being selected. The imports of ingots, blooms, slabs, billets and bars of steel were, in 1888, 414,489,698 pounds, and in 1898, 30,821,157 pounds. The imports of wire rods for the same years were 276,939,550 and 39,601,639 pounds. Of tin plate the figures are for 1880, 634,944,945, and for 1898, 171,662,345 pounds.

The exports of bar iron in 1888 were 1,508,426 pounds and in 1898, 12,308,615 pounds; of wire, in 1888, 12,734,195 pounds and in 1898, 136,951,924 pounds. The value of the locomotives exported in these years was $407,014 and $3,883,719.

In every country in the world, and in practically every inhabited island where articles of civilized or semi-civilized use are required, American manufactures of iron and steel now find purchasers. Wire nails are perhaps most widely distributed, while American sewing machines, and electrical instruments and machinery also are spreading everywhere.

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The New Orleans Progressive Union, of New Orleans, La., has issued a circular containing statements designed to show the advantages of that point as a location for furniture manufacturers.

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A Record of Experience.

To judge from past experience we shall after about one year receive at frequent intervals letters which will read about as follows: "You published some time ago some articles showing how to make original index wheels. We would like to know whether we can procure these numbers, or if the articles have been published in book form."

To such inquiries we shall be obliged to reply that "the numbers containing these articles are out of print, that they have not been published in book form, that so far as we know no other publication contains the same or anything like as much information upon the machine shop processes involved in originating index wheels, but that the numbers can now be seen only in libraries where the paper may be on file."

The series of articles which has been called out on this subject is, taken altogether, somewhat remarkable. They probably come pretty nearly revealing the state of the art as it exists to-day in machine shops. They are invaluable to anyone who may be confronted with the problem of producing an accurate, original index wheel, and to us it is incomprehensible that anyone concerned in machine construction can be content to miss seeing such articles or to assure himself that he has them where he can refer to them at any time when necessary.

We speak of these particular articles only because they constitute a recent example and are the first which suggest themselves. There are many others of which the same thing might be said, and the fact that there are machine shops in this country in which they are satisfied to go on constructing machinery on the basis of their own relatively narrow experience and without attempting to take advantage of the broader experience of others, is a phenomenon not readily understandable, especially in view of the general high degree of intelligence found among machinery men.

A short while ago a representative of this paper, visiting a factory, found them struggling with a problem of a special nature in which the principal operation was the grinding of a small, thin, hardened piece of steel requiring to be accurately gaged. For several months the superintendent, one or more draftsmen and several toolmakers had been either steadily or intermittently working to solve the problem of producing this piece of grinding with sufficient accuracy to answer the purpose, but without success or even perceptible advance. A reference to articles that had been published in the "American Machinist" during the past year or so, and emphasizing the necessity of an abundant flow of water upon the wheel and work in such operations, immediately solved the difficulty and showed that all the previous work had been misdirected. This is one of the many instances wherein it is clearly demonstrated that no man can afford to deny himself the advantage of the experience of others in his chosen occupation. It is a matter of continuous wonder how a proprietor of a machine shop, for instance, can think of neglecting to avail himself of this assistance in his business, but nevertheless there are those who do this, and after all it is, we suppose, only one of many ways by which those who are enterprising and interested in their work are able to distance others in competition. The best shops, having the best men, and where it would be thought they needed such assistance least, are the very ones which take the most pains to make full use of every such agency.

The Men Behind the Engines Behind the Guns.

In the complete and utter overwhelming of the fleets of Spain we have added a unique page to the world's enduring record. The unmitigated catastrophes to the squadrons that sank under the fire of our ships at Manila and at Santiago are not to be matched in all the tales of all the wars. The glowing official reports of these sweeping victories we believe it would also be hard to match.

For instance. In the story of the racing fight at Santiago, Admiral Sampson, Commodore Schley and Captain Clark all report the remarkable steaming of the Oregon. Captain Clark says that she made 16 knots, and that this magnificent speed it was that enabled him to forge ahead and to do the terrible execution with his guns and to extinguish poor Cervera's career. Are there not cheeks that will yet tingle with shame over the disgraceful fact that not a single engineer or fireman or machinist is named or praised in any of these three reports. "There was glory enough for all," but not enough for those in the hell below the deck.

It is idle to waste words over the functions of the modern floating fighting machine. We all know, and all the world knows, how entirely and absolutely it is the creature of steam, and how its every detail of movement is dependent upon the precise action of the intricate devices by which steam power is applied to the various service required. Every telling operation in the work of the vessel, not merely the maintenance of speed, but the steering, the manipulation of the guns, the conveyance of the ammunition, is done by steam and mechanical means entirely. It is not for all of us to know the life and death struggle of the fire room, with the superadded heat of the tropical summer, the watchfulness, the skill and the endurance of the men behind the engines behind the guns, but the writers of these reports knew these things well, and who can see but with keen regret that in the great day of their lives they forgot (or did they forget?) common justice and right for their most trusted and most necessary co-workers. The officials who receive these reports also should know how modern battles of the sea are won, yet not one, as it appears, could raise a word of inquiry as to whether these men were in the fight or not.

It cannot be but that there is a day coming when such flagrant injustice as this shall no longer flourish, and we must keep telling the story of it until the time comes. "The engineer in history" is a chapter yet to be written, but he will have his page, and others must yet give place to him and no longer entirely usurp his honors.

A Proposed Increase of German Duties on Machinery.

On several occasions we have referred to the more or less persistent effort being made by machinery manufacturers in Germany to secure the passage of a law there imposing an import duty upon machinery commensurate with the duty charged here. We now learn from a source which we consider reliable that the recently elected members of the Reichstag have been elected largely with this issue in view, and that a poll of the entire membership, which has been taken, shows that a bill imposing such a duty will almost certainly pass in the coming session.

It is said that German citizens who wished to avoid the enaction of such a law have made an effort to come to some understanding with our Government upon this matter, but that they have failed, and if, as now seems probable, such a law is passed next winter it will be a serious blow to our export machinery business. Of course, it will be said that we cannot blame the Germans for imposing upon our machinery the same rate of duty as we impose upon theirs; which is true enough, and it would seem from a superficial view that the two equal rates of imports would place us upon an even basis. But every day transactions show that this would not be true, and that the only practical effect of the two equal and high duties will be to restrict our exports of machinery to Germany, since under no conceivable conditions would we import machinery from Germany in any great quantity, no matter how low our tariff might be. The fact is, we have been sending machine tools to Germany in large numbers, simply because we can build such tools, quality for quality, more cheaply than they can be produced there. This makes our import duty on such tools of no use whatever to our builders, and, as we have previously pointed out, its only practical effect is to provoke other countries into imposing retaliatory duties and to give them apparent justification for such retaliation. We shall hope that the proposed action may be in some way avoided, but we think it is clear that there must be some change of ideas regarding these matters if we are to continue a large business outside our own country. The Germans say "we cannot buy from you unless you will allow us to send you something in exchange." The force of this statement we cannot deny, and so far as machinery is concerned, it would seem as though we should take such action as will be most favorable to our machinery interests and remove all justification for the claim that the builders of other countries are unjustly discriminated against. Then the contest for trade will be an open and fair one, and will be conducted upon its merits. In such a contest the business of the past few years shows very clearly that our builders will have no cause to fear results.

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The Naval Engineers at Santiago.

Lieutenant Commander Wainwright, who commanded the Gloucester, in his report, says: "That we were able to close in with the (Spanish) destroyers, was largely due to the skill and constant attention of Passed Assistant Engineer Geo. W. McElroy. The blowers were put on and the speed increased to 17 knots, without causing a tube to leak or a brass to heat."

Another chapter in the story of the engineers' work at Santiago is to the effect that during the maintenance of the blockade against Cervera's fleet it was the custom of the American ships to display at 12 o'clock noon each day a signal indicating the amount of coal burned during the previous twenty-four hours. The consumption of coal by one of the vessels was always greater than that of any of the others, which was to be expected from the fact that she was larger, but this explanation was not satisfactory to the executive officer, who fretted and fussed about it to such an extent that the engineers felt obliged to do something to satisfy him, and it was finally decided that the best way of doing this would be to arrange to throw a portion of the boilers alternately out of use, and this was done, reducing the coal consumption to what the executive officer thought it should be. The result of this was that when Cervera came out this vessel could not get up steam and speed quickly enough to be in the fight to any great extent, and the executive officer now greatly regrets, when it is too late, that he did not listen to the reasonable explanations of the engineer officers. The real reason for the vessel's lack of promptness will, however, probably not appear in the official reports of the engagement.

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Symmetry in Machine Design.

British machine tools seem unnecessarily ugly in American eyes, but we have always been haunted by the fear that this was due to nothing more than prejudice. It is therefore somewhat comforting to find in the columns of an English contemporary an editorial article entitled "Structural Appearances," in which the following passage occurs:

"The examination of the machine tools made in this country and those made in America will reveal the fact that our cousins across the water have paid considerably more attention to their external appearance than we have at home, while recent experience has shown that the quality and usefulness of the American tool is certainly quite up to that made in this country.

"Excess of material does not always mean extra strength, but it is the judicious arrangement of the material at one's disposal which constitutes good design."

We venture to hint that usefulness and appearance are not always widely separated, though the latter may not always be a necessary outcome of the former.

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Inquiries for Machinery.

Those who make, or may know of the makers of such machinery as is called for below, will oblige us by sending name and address, mentioning the number of the inquiry. We cannot forward catalogs. We have inquiries as follows:

61—From England for a machine for polishing steel wire.

62—For makers of small double cylinder reversible engines of about 20 horsepower, to be run by compressed air. Engines are required to be portable and to have a speed of not less than 400 revolutions per minute.

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Obituary.

Mrs. Sophia Braeunlich, business manager of the "Engineering and Mining Journal," of this city, died in Brooklyn August 11, forty-five years old. Mrs. Braeunlich, born in Brooklyn, was educated in the finest schools in Germany, became a widow while still very young, and entered the office of the "Engineering and Mining Journal" in 1879, and rose successively to the position occupied at her death by ability and devotion to her work. She was the first woman elected a Fellow of the Imperial Institute of London.

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The Navy Department is inviting sealed proposals until August 30 for two pairs of runways, erected on foundations in building No. 20, Brooklyn Navy Yard, together with lateral bracing and two electric traveling cranes of 20,000 pounds lifting capacity, with three motors each, for lifting and traversing the same with loads. Each machine must be of the latest modern design and must be delivered within sixty days after receipt of order. Intending bidders can obtain specifications and blank forms of proposals upon application to the Navy Pay Office at New York or to the Bureau of Supplies and Accounts, Washington, D. C.

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Referring to Professor Sweet's footstock, Mr. J. C. Watson, Montpelier, Ind., suggests that it would be convenient many times if lathes were made with a hollow footstock spindle, and he proposes that it may be done by simply enlarging this spindle sufficiently to admit of the use of a hollow screw.

Foundry Appliances.*

Foundrymen, as a rule, pay close attention to the general outfit of their foundries. They are careful in the selection and in the construction of their cupolas, their blowers or fans, their core ovens and cranes. Taking into consideration the various purposes for which different foundries are fitted, whether for casting light or heavy machinery, stoves, hardware, pipe, rolls, malleable iron, steel or bronze, each has its peculiar arrangements, and each may vary considerably from others in its details; yet the general rule of equipment is followed by all. Of course, every foundryman knows there is considerable difference between the cupola of a gray iron foundry, the reverberatory furnace of the malleable foundry and the open hearth furnace of the steel foundry; but excepting these latter, which properly belong in a class of themselves, the gray iron foundry equipments very much resemble each other. Likewise the supplies are very much the same, though each specialty has its peculiarly adapted sands, facings, etc. But there exists a wide range of divergency in the foundry appliances, which are to be separately grouped from the fixtures and the supplies.

Conveyances for the raw material are mostly limited to the elevator for pig and coke. In some instances an elevated track is provided which furnishes the material at a level with the charging floor, while in most cases, mechanically, electrically, or hydraulically operated elevators are made use of for this purpose. Comparatively few foundries are equipped with sand conveyors; though, where introduced and where intelligently manipulated, they effect a considerable saving in labor. Conveyances for handling the molten metal are usually a traveling or swinging crane or both.

The next important things for the foundryman are his flasks. These may be divided into wooden and iron flasks, and again into ordinary and snap flasks.

Adding to the equipment mentioned above, the cleaning barrel and a core oven, we have a full outfit of an ordinary old-fashioned foundry, which would be ready to make and furnish castings for the market. It is questionable if such a foundry could hold its own in our days of advancement, or if it would compete with current market prices and leave a margin for its owner. Labor runs the cost of castings up, and the saving of labor brings it down. He who can save most in the production will profit most in his transactions. Work can be performed either manually or by mechanical devices or by both means. Judicious selection, introduction and application of labor-saving machines is the only solution of the problem of competing with others and drawing dividends from an investment.

The modern foundry includes in its equipment sand conveyors, molding machines, sand mixers, drawboards, machines for cutting off sinking heads and gates, sand blasts, chipping tools, emery wheels, and a fully equipped chemical and physical laboratory. These appliances are of a great variety of construction, the maker of each one claiming special advantages. A great number of them are constructed to meet special requirements; most are adapted for special purposes, while few can be used for a general run of work within certain ranges, and hardly any advantage is offered to the jobbing foundry. In view of this we may ask the questions: Has this ground been fully canvassed? Have all improvements been made which can be made? Must we stick to our old fashion? Cannot we simplify present methods? Cannot we reduce our present expenses, and where could a saving be effected?

Let us take a walk through the foundry and see. We can naturally discover the faults of others and make comments on their shortcomings, though we may not be able to do better. Entering the yard we happen to see a carload of pig iron unloading. There are five or six laborers at work, each one doing his share to hand out the pigs, which others carry to the pile. There are certainly means to do this cheaper and easier; and if there are none, such means certainly can be provided. One would think that a simple overhead track, conveniently arranged with relation to the rails on the ground, and equipped with a hydraulic, pneumatic or electric hoist, which is especially adapted to the purpose, would replace all the men but one to do the work quickly and cheaply.

Passing on, we see another gang unload a carload of molding sand; others wheel it into the foundry. Coke and sharp sand is handled in a like manner. No attempt is made, apparently, to save in the number of employés. They are certainly all old hands, and they must be supplied with some kind of a job. That is very considerate, indeed, but surely it is not very profitable. Why not get the sand in hopper cars, unload it with the aid of scoops, and transport it from its bins by a suitable conveyor to its destination? Why not provide similar modern labor saving appliances for handling the coke, and delivering this as well as the pig iron upon the charging platform? There is certainly too much time, too much labor and too much money wasted before the materials have reached their place in the foundry.

We take a few steps further and lose our way in a labyrinth of flasks, justly thinking that the poor fellow who has to hunt for a few of a particular size must lose his courage at the beginning. Of course, they have accumulated for years. They are too valuable to be destroyed; they may be called for at any time, and even if a board or two are eventually rotten and have to be replaced, it seems to be gratifying to live under the conviction that the right size may be on hand if an odd job turns up unexpectedly. Does not the space required for their storage seem to be a waste of room, which might be made use of for a better purpose? Does it not appear as if, in such a quantity of flasks, a great amount of money is invested, which pays very little dividends? Is this really a necessary evil for which we have no remedy? Apparently this question has not received proper attention from the foundry manager.

I have here a little model of a flask, which, by means of this little lumber pile, I will be able to change into flasks of twenty different sizes in less time than it would ordinarily take to hunt for a flask of the required size. Quite recently I had made a dozen sets of these flasks, which, when assembled, represent seventy-two full flasks, though they replace, in fact, 240 flasks of twenty different sizes. I have, therefore, reduced this particular flask pile exactly 66 2-3 per cent. I mention this matter merely to demonstrate one way of overcoming an apparently necessary evil, which may be an incentive to follow this matter up and lead to further improvements.

Now, let us step into the foundry itself and see if we can suggest there any improvements. It is really well equipped. It has good cupolas, an electric traveling crane, sand riddles, sand and loam mixers, several good molding machines, adapted to special, always recurring work, sand conveyors and other appliances which are only found in the modern foundry. Each of these seems to suit its purposes admirably, and each has been carefully selected from among the best on the market. None but intelligent workmen, who are fully acquainted with all the details of these machines, may be able to call our attention to some of their weak points—points, however, which may be profitably examined. Trifling improvements of factory appliances which suggest themselves during their service prove always of advantage to the manufacturer. The observing foundry manager, seeing his machines daily at work, will discover the shortcomings without his attention being called to them; and the progressive one, if he is not an engineer himself, will consult a mechanical engineer with the object of bringing his plant up to perfection. In some instances almost marvelous results have been obtained in molding with the aid of molding machines. The output of the foundry has been increased, and skilled men have been replaced by common labor. But so far there has not been constructed a really serviceable machine for a variety of articles as they occur daily in the jobbing foundry. Odd

*By S. H. Stupakoff. Read at the May meeting of the Pittsburgh Foundrymen's Association, slightly abridged.

castings will always be molded by hand. Only where large quantities of the same articles are required again and again is it profitable to apply patterns to a molding machine. And then the main feature in such machines will be always the withdrawing the patterns from the sand. The ramming of the flasks will have to be done in most instances partly by hand, though in some cases it may be admissible to accomplish this with the machine. The shape of the pattern will determine whether one or the other of these methods is preferable. The easiest and cheapest way to prepare patterns for the production of quantities with the aid of molding machines or drawboards is to secure them to plates, which are fitted accurately to their flasks. Each case, however, will require some ingenuity if satisfactory results are to be obtained. Molding machines in general are good labor-saving appliances in the foundry; they increase the output and do not entirely dispense with the service of manual help. It is not likely that we will ever reach the point of building entirely automatic molding machines, which can be kept on a run of the same kind of casting, without the aid of human agency.

A modern foundry, with or without molding machines, is not complete unless it is equipped with a good system of sand conveyors. They deliver the molding sand automatically to the place where used. They dispense with the wheelbarrow, and, to a great extent, with the shovel. A great variety of these appliances are in daily use, all giving more or less satisfaction. In selecting a conveyor for a new plant preference should be given to a device in which all the moving parts are not subject to wear and tear by friction and are removed as far as possible from the sand itself. Hinges made of flexible material, such as leather or rubber, serving as connections for elevator buckets, scoops or trays, give excellent satisfaction, and are in all cases preferable to metallic pin butt connections. What has been said about the delivery and distribution of molding sand is likewise applicable to the removal of burnt sand from the foundry. Labor is reduced in both instances, and the conveyor is an economical, reliable and untiring help in the foundry. Conveyors for the transportation of flasks, empty or molded, or molded and cast, are used in rare instances only. We have an excellent arrangement of this kind in our immediate neighborhood in the foundry of the Westinghouse Air Brake Works at Wilmerding, Pa., which has been described in all periodicals paying attention to subjects of this nature. The introduction of this or a similar system is equally advantageously applied in all foundries, producing castings in quantities within certain limits of weight.

This embraces about all that can be said in a general way about the present application of conveyors in foundries. To my knowledge, nothing successful has been used, so far, to convey the molten metal from the cupola to various parts of the foundry, unless a crane or hoist is employed for handling the large stock ladles. This, however, does not solve the problem. Ladles holding more than 100 pounds are carried as before by two or more men from the cupola to the flask, and here we have certainly room for improvement. When pouring-off time comes the foundry is generally short of hands, and everybody in and around it is compelled to pitch in. This deficiency induced me to devise some means whereby each molder can handle his fluid metal without the aid of others, and I am just about ready to give it a test in the foundry forming part of the works where I am engaged. There is no doubt that if the scheme works, as I imagine it will, I will be able to reduce the cost of our castings considerably.

We will now go back to the subject of flasks. Much valuable time is consumed in their selection, their preparation and their transportation to and from the foundry. Pneumatic hoists liberally distributed throughout a foundry will prove valuable savers of time for transporting, lifting, reversing, turning and closing the flasks, for transporting and setting heavy cores and for lifting and removing the castings from the foundry floor. The introduction of pneumatic hoists in a foundry furnishes another valuable accessory to the molder in placing at his disposal compressed air, which not only replaces his hand bellows for ordinary practice, but is also an easy means of cleaning the patterns and stripping plates of molding machines.

The clamping of the flasks enters as another factor of cost in the production of castings, which to my mind is an unnecessary expense. Means should be devised to clamp the flasks more quickly than at present, and, at the same time, at least effectually. There are several kinds of improved screw and lever clamps in the market, any one of which is superior to the old hook and wedge clamp. It takes a molder ordinarily half an hour to clamp up his flasks for a day's heat, which time is partly lost in hunting for and selecting the right kind. A serviceable clamp, forming part of a flask, which could not be lost and would always be ready for use, would be the ideal thing in the hands of the molder.

Cleaning barrels, which are known by some as rumblers, by others tumbling barrels or rattlers, are in extensive use in nearly all foundries. They should always be provided with exhaust pipes to carry off the dust and burnt sand removed from the surface of the castings. They should be placed on a good foundation and protected by an outside shield or covering. They are always better outside the foundry than within. Many foundries rely upon the cleaning to improve the appearance of their castings by "running them through the mill." Rumbling, however, will not in all cases remove the molding or core sand sufficiently for tooling. Especially where castings are faced off or worked out with expensive milling or complicated boring tools, it is advisable to put them through a pickling bath. Diluted sulphuric acid, which was used until quite recently for this purpose, has been replaced of late by hydrofluoric acid, which gives unquestionably better service. It is best to keep it in a lead-lined tank or box, which is provided inside with strong wooden lattice work. Neither wood, lead nor iron is appreciably attacked by the acid, while it actually dissolves the sand adhering to the castings. The wooden lattice work protects the lead from injury, and allows the sediment to drop below the false bottom of the bath.

But a casting is not finished after it leaves the tumbling barrel. Gates and pins have to be chipped off to make a presentable piece of work. Sinking heads and gates of large castings are mostly cut off by circular saws, while hammer and chisel usually do the rest. We have seen what extensive use we can make of compressed air in the foundry. And right here we have another application by replacing the ordinary hammer and chisel with pneumatic chipping tools. They accomplish about three or four times the amount of work which one man turns out in the old-fashioned manner.

A further valuable application of compressed air could be made by the installation of sand-blast machinery for cleaning castings. I have personally never seen one of these sand-blast machines in use in a foundry, but I have seen them used successfully in glass factories, and the results obtained therefrom convince me that they are equally as good for cleaning castings.

Sand mixers, constructed after the principle of centrifugal machines apparently give the best satisfaction. In selecting the right kind, attention should be paid to the minor details of construction. Its bearings should be well protected, so that no sand or dust can locate between the rotating parts and their journals. Its pulleys or driving mechanism should be conveniently arranged to suit each special case.

The only subject remaining which requires mentioning in this paper is the chemical and physical laboratory, which, though really not a part of the foundry proper, should always take the first place in its equipment. Much has been said about it of late by men who are far better able to speak about it than myself. In referring you to the exclusive literature on this subject, I will merely urge that the introduction of the laboratory should be carefully considered by all foundry managers, for I am convinced that it will

unquestionably result in a profit for the manufacturer.

Finally I wish to call your attention to a paper by Mr. Paul Kreutzpointner, where mention is made of the segration of the various components in cooling liquid metal. The ordinary process of crystallization is well known to all, and there can be no doubt such action of segration can be effectually prevented by pouring the metal at the lowest possible predetermined heat. To accomplish this readily and positively, we have but one resource, and that is by measuring its temperature. Several large foundries in Europe, among others Krupp, in Essen, Germany, have used the Le Chatelier pyrometer quite successfully for this purpose, and this instrument is just now being introduced for the same purpose in several of our progressive large foundries. We shall certainly hear in the near future of the results which have been obtained by its application, and we may expect that the pyrometer will find a prominent place among the latest and most useful of our foundry appliances.

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A Japanese Mercantile Missionary In America.

We were talking the other day with the manager of a house dealing in a certain line of goods akin to machine tools, and in the course of the conversation he remarked that although there was reputed to be in Japan a good market for American wares he was unable to lay his hand upon it. To such as he is addressed the mission of Mr. Shizuo Kondo, of Tokio, president of the Japan-American Commercial and Industrial Association, who is now at the American office of that body, "Times" Building, New York.

This organization is an international trade agency, which has started a very enterprising monthly called the Japan-American Commercial Journal," printed half in English and half in Japanese, and is preparing a commercial director comprising 100,000 names, with financial ratings, in Japan, Korea, China, Philippines, Straits Settlements and Hawaii. It will exhibit at its Japanese office catalogs and samples of leading American manufacturers and will cheerfully furnish information to associations or individuals. The cost for associate membership is $25 per annum, this sum entitling to the receipt of publications, use of directory and twenty-five special reports on investigation. The body claims to be of the same more or less disinterested character as the National Association of Manufacturers in this country. Its honorary membership numbers many distinguished names, such as the American Minister to Japan, the Japanese Minister at Washington and other high Japanese officials.

Mr. Kondo is a graduate of Columbia College, so is in a position to deal intelligently with the affairs of both countries. His purpose is to show that the export trade of America with Japan has not received nearly the cultivation it deserves, although great progress has lately been made. The imports into Japan from the United States increased from $8,186,704 in 1896 to $13,517,268 in 1897, while her exports to the United States increased from $15,766,170 in 1896 to $26,218,202 in 1897. This shows that there continues to be a large balance of trade in our disfavor. Only Great Britain, China and British India, however, surpassed us in the exports to Japan in 1897. Among the articles in which our chief gain was made were steam engines and boilers, locomotives and electrical, spinning and mining machinery. A great variety of machinery, including iron and wood working, is now in demand.

Mr. Kondo was interviewed by a representative of the "American Machinist," and besides furnishing us with most of the above information made the following remarks:

"The sentiments of Japan toward America are so friendly as to make it incline to trade freely with this country, but in the past the English and Germans have received an unduly large proportion of the Japanese orders because of their aggressive business methods, while the United States has been relatively negligent in pressing her claims. Here is a German circular filled with engravings of files, saws and the like, which the Japanese buy largely from the Germans, because the latter get up such circulars for the Japanese market, while the Americans neglect to advertise there.

"At present the sales of American wares in Japan are made largely through the agency of commission houses situated in the latter country. The opinion that the Japanese, as a rule, are lacking in financial responsibility is fostered to an unconscionable extent by the commission houses, to whose interest it naturally is to prevent dealing by the American manufacturer directly with the Japanese merchant or consumer. For instance, I know of a case in which the representative of an American concern went to Japan, but being ignorant of the Japanese language he was secluded in the foreign colony there and hedged about by the commission houses so that he returned home unaware of the true situation. While we do not wish to criticise too harshly the commission houses, which do a good work in some ways, we advise Americans to communicate directly with representative dealers in Japan, whose names and financial rating our association will furnish. In that case we will make such arrangements that by means of a bill of credit the American manufacturer will be able to draw his money upon presentation of his bill of lading at a certain bank. Thus his business will be transacted upon a cash basis.

"American machinery in Japan is in very good reputation. Until quite recently the Japanese imported their machinery from England and Germany, because these countries were aggressive advertisers. By this time, however, the Japanese have learned that they can buy better machinery at better prices from this country. Some can be obtained more cheaply from Germany, brass-working machinery, for instance, but it is not as good as the American.

"The Japanese do not themselves build machinery, because it is cheaper to buy it from the United States ready made than to import the raw materials and work them up at home.

"Electrical machinery for power and lighting purposes is all brought from America. A long-distance telephone system has just been installed between Osaka and Tokio. It is controlled by the Japanese Government. The material has come from the Western Electric Company, of Chicago and New York. Four large water-power transmission systems are now expected to be installed in Japan. They are located respectively at Osaka, Hakone, Kioto and near Tokio. They represent many millions of dollars in capitalization. Japanese engineers are now making investigations tentative to the equipments, and in the course of four or five months will probably arrive in this country to purchase machinery. Two electric railway undertakings may be mentioned. One is a road which will run from Atami Spring to Yokohama, along the route of an ancient military road. The other connects Tokio and Kawasaki. Both roads will probably use American electrical machinery, though I fear that the contracts of the latter have already been let."

The attention of Mr. Kondo was attracted by the advertisements in the "American Machinist" as representing lines of manufacture especially adapted to the Japanese trade.

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Commercial Review.

NEW YORK, SATURDAY EVENING, Aug. 20.

DYNAMOS AND MOTORS.

The tone of the electrical machinery market is always healthy as compared with that of other lines, and at present we can see nothing in its condition open to criticism. The rush of work in shops continues; in fact the cataloging of manufactories in this branch of industry that are running night and day is getting to be an old story. Reports of increased business are received from various quarters, and so, to appearances, the demand is freer than it was a month ago. It is still hardly time for the letting of contracts for winter lighting supplies to the extent that may be anticipated before cool weather. In regard to exports, a statement has appeared in print

this summer that a single manufacturing company has had at once on its books orders for between $4,000,000 and $5,000,000 worth of electrical apparatus of various kinds, for shipment abroad. In view of the fact that the entire exports of electrical machinery for the fiscal year that closed June 30 were but a trifle over $2,000,000, hardly half the sum named, the statement may be open to question. Yet if the growth of the trade be considered, also the fact that the number of manufacturers extensively engaged in it is comparatively small, and, furthermore, that the orders said to be booked might include a large proportion of electrical supplies not classifiable as "machinery," we are unprepared to say that the report was inaccurate. In connection with the topic considered under this heading, we must refer to the interview with Mr. Kondo upon the Japanese market, appearing elsewhere.

In the last number of the "American Machinist" we mentioned the considerable number of applications that had been made for space for American industrial exhibits at the Paris Exposition of 1900. It appears from a letter from a special Parisian correspondent of the "Journal of Commerce," New York, that in some respects our national representation is likely nevertheless to be deplorably lacking. The motive power of the fair is to be electric, one-half furnished by French manufacturers and the other half by foreign bidders. Already most of the allotments of motive power have been made, but the Americans have not yet come forward. England, Belgium and Switzerland have been awarded their shares of the contracts, and Germany, having received three already, is anxious for three more. In spite of the good nature with which the French authorities have waited for the American bidders to appear, it looks as if they would ultimately have to let the rest of the awards to other nations. Moreover, this may result in a cutting down of the room allotted to the United States for exhibits, which was made larger than it might otherwise have been because of the share which it was supposed they would take in furnishing material for motive power. Another negligence on the part of this country is its omission to provide for a national building.

A report was afloat recently that the Brooklyn Elevated Railroad intends to equip its lines with electricity, but we have not heard of any definite steps taken in that direction, although we have inquired of some of the companies likely to be informed upon the subject were contracts for electrical machinery let.

Tin has long been one of the most valuable among the ordinary base metals and at the present price of over 10 cents a pound, even in large quantities, has become especially so. Perhaps many persons have reflected upon the amount of it that is constantly being wasted upon old cans and have wondered whether there were no way of reclaiming it. The Vulcan Metal Company, whose works are at Sewaren, N. J., has undertaken the task of redeeming tin from scrap metal and has purchased two 100 kilowatt Bullock dynamos for use in its operations. Apparently in the days of economic invention now arrived the goats will have to subsist without their traditional dainties.

The Bullock Electric Manufacturing Company is also shipping a 100 kilowatt motor-dynamo "booster," to be used upon a street railway in Rio Janeiro. We understand that the same electric company has in prospect some important work, connected with electrical power, as to the nature of which there may be occasion to say something in the future.

Vickers' Son & Maxim, of England, have placed an order for six special slow speed C & C motors of 50 horse-power each, to run gun lathes. Waygood & Co., a large English elevator building firm, has ordered thirteen special, slow-speed C & C ironclad motors, to be direct connected to elevators. The United States Government has been buying some switchboards of the C & C Electric Company, whose works, it may be remarked, have now been running on night turn more or less completely throughout the departments for a whole year.

Two large orders have recently been placed for Crocker-Wheeler motors for driving printing presses. They are for Bradstreet's printing office, and the New York Life Insurance printing house. The motors in each case will be connected with the individual presses.

H. B. Coho & Co., agents for the Eddy Electric Company, have lately sold six new motors for direct attachment to machines in the works of the John Stephenson Company, Elizabethport, N. J. The same firm recently received a rush order for a 50 kilowatt lighting plant to be installed on board the United States hospital ship Missouri. The engine was a Watertown. A local sale made by the same electrical firm was a lighting plant for the Livingston Apartments, the engine plant in that case being Straight Line.

The General Electric, the Westinghouse and the Walker companies are all occupied with a satisfactory volume of export work. The probable nature of the new West Indian market is now beginning to claim some attention.

A representative of the Walker Company informs us that business is decidedly improving, street railway work included.

The works of the Sprague Electric Company continue to be crowded with work. They are sold out up to October, and it is found impossible to execute orders as speedily as desirable.

It is said that a large electric lighting plant is likely to be required for a new hotel on Thirty-fourth street, this city.

MISCELLANEOUS.

Two traveling cranes with runways are wanted for the New York Navy Yard. Bids will be opened August 30.

Advices from London are to the effect

(*Continued on page 38.*)

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Cutters, reamers and small tools, regular and special; vertical millers, cutter and surface grinders, shears and punches. R. M. Clough, Tolland, Conn.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Automatic machinery designer; 6 years' best experience; graduate. Box 185, AMERICAN MACHINIST.

Practical mechanical draftsman desires position; 14 years' first class experience. Box 201, AM. MACH.

Draftsman wants change; first-class exp. on light aut. and bench machinery. Box 198, AM. MACHINIST.

Foreman, pattern and draftsman; a good, steady, reliable man; good ref. Box 202, AMERICAN MACHINIST.

Practical mechanical man desires partnership or stock in corp., with position. Box 204, AM. MACHINIST.

Mechanic wishes situation with reliable firm as foreman or superintendent toolroom or light machinery. Address Box 193. AMERICAN MACHINIST.

Wanted—Mech. position in charge of manufacture of small machy. or general repair work: accustomed to management of men; best of refs. Box 174. AM. MA.

Mechanical engineer, graduated in '93, wishes to change; drawing office and shop experience with leading concerns in elevators, engines and machine tools; would travel. Box 203, AMERICAN MACHINIST.

Foundry foreman, a first-class man with special experience in one of best shops in this country is ready for an engagement; understands brass as well as iron founding; selecting and mixing irons a specialty for any purpose. Address Walter Wainwright, 87 Stone Street, Cleveland, Ohio.

Young engineer, successful designer of multi-cylinder Corliss and slide valve engines, high duty pumping engines, blowing engines, air comps., hoisting and mining plants, mach., foundry and boiler shop equip., 5 years shop and erecting, 10 years office, desires to negotiate a change. Box 197, AMERICAN MACHINIST.

Help Wanted.

Wanted—Expert machinists, floor and machine; also expert molders high speed engine work; name, ref. and wages ex. Phœnix Iron Works Co., Meadville, Pa.

Wanted—First-class mechanical draftsman to go to the country; one accustomed to mill work pref.; state age, ref. and salary required. Box 192, AM. MACHINIST.

Wanted—A thoroughly competent machinist to give instruction in a shop connected with an engineering school in Mass.; state exp., age, compensation required and send photograph to Box 182, AMERICAN MACHINIST

Wanted—A thoroughly competent man of exp. to superintend eng. fac.; one prepared to purchase an interest in the bus., which is well estab and profitable, pref.; must be first-class, up to-date machinist and understand handling men; a splendid opportunity for the right man. Box 189, AMERICAN MACHINIST.

Wanted—By a company mfg. a general line of engine work, ambitious young men who have served their regular apprenticeship and are looking for a permanent position in a shop where faithful service is appreciated; in replying state size and kind of machine and work you are most accustomed to; state wages desired. Engine Company, care of AM. MACHINIST.

(*Continued from page 37.*)

that only small orders for machinery have, as a rule, lately been placed, but that a revival is expected to occur early in September, at which time some large contracts now pending will be closed. The most active line is mining machinery for South Africa. The English do not receive the entire benefit of this trade, however, for a considerable share of it is coming to the United States.

CHICAGO MACHINERY MARKET.

The late improvement in the business world cannot be so well measured by the market for motors and dynamos as in other departments of manufacture, for the reason that the electrical trade has been steadily good for some time past. This activity continues. There is enough business to keep all manufacturers represented here at least fairly busy, and some are running overtime. But, notwithstanding this satisfactory state of trade, complaint is heard among some sellers that prices are not what they ought to be. Not only has there been no advance, but some makers are said to be even shading the values that have existed for months.

General machinery makes slow but steady advances along the highway of trade. Quite a number of new deals are reported to be under way, but the business actually closed during the past week has been more moderate.

It is a somewhat significant fact that inquiries for steel manufactured at Chicago have come during the past few days from territory that is naturally tributary to the more Eastern centers, indicating that the scarcity of crude material, which has been noticed here for some time, is now general. Prices for billets, bars, plates, rods, pig iron and similar material are stronger by from $1 to $2 per ton.

The Q & C Company reports a much better trade during the past two weeks. It has just closed an order for a No. 15 power sawing machine with the St. Louis & Southwestern Railroad system, and has recently closed a number of other similar orders. The company is now two weeks or more behind in all departments. It is pushing work on the addition to its plant at Chicago Hights, which will double its capacity. From present appearances the new building will not come any too soon.

The machinery business at Chicago and Cleveland which has heretofore been conducted by the Prentiss Tool & Supply Company will hereafter be conducted by the Marshall & Huschart Machinery Company. Mr. Alfred Marshall, who for eight years has been manager of the Western branch of the old company, will be the manager of the new, and Mr. H. C. Elliott will remain in charge of the Cleveland branch. The company will continue to handle the products of the Prentiss Tool & Supply Company. It

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Best Calipers, Levels, etc. E. G. Smith, Columbia, Pa.

Book, Dies & Die Making, $1. J. L. Lucas, Prov., R. I.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Wanted to build small specialty; also dies for metal work. Rankin, New Bedford, Mass.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Die makers, special mach'y and spec'lt'es wanted for manufacture. Bown Mach Works, Battle Creek, Mich.

Wanted—Second-hand lathe, 40 to 50 inch swing, at least 8 feet centers. Fraser, Room 201, 26 Cortlandt street, New York.

One dollar will be paid for copy of THE AMERICAN MACHINIST, issue of June 6, 1895, No. 23. Address BOX 196, care of AMERICAN MACHINIST.

Wanted to Purchase—One 6 ft. second-hand boring and turning mill of some standard make; state condition and price. BOX 195, AMERICAN MACHINIST.

Wanted—Lathe not less than 94 inch swing; also planer not less than 60 inch between housing, 48 inch high x 16 feet, with two heads; both must be first-class tools. Address BOX 194, AMERICAN MACHINIST.

The advertising department of the American Machinist has on hand 20,000 draftsm'n's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

Institutions retiring from business having machine tools, brass or wood working machinery, will find it to their interest to correspond with us. We purchase complete plants or handle them on com. .C. C. Wormer Mach Co., 55-59 Woodbridge st., W., Detroit, Mich.

The advertiser wishes to obtain financial backing for introducing an entirely new line of labor saving mach. tools on the European market; the machs. are being built at present and are undoubtedly a great advance over current practice. Ad. BOX 199, AM. MACH.

Wanted—To lease for term of years machine shop equipped for light and heavy jobbing, capacity forty men, or to arrange with reputable concern for manufacture of line of special machinery; replies to receive attention must give full particulars as to class of work equipped for, capacity, &c.; location must be vicinity of New York. Address BOX 200, AMERICAN MACHINIST.

The CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 120 gals. per day. Used in 18 countries. Testimonials from the leading firms in every field of industry.

THE BURT MFG. CO.
AKRON, OHIO, U. S. A.

Business Established 8 Years.

Largest Manufacturers of Oil Filters in the World.

WANTED.

Two horizontal boring machines to be used for boring cylinder liners of gas and oil engines, from 6 to 18 inches diameter and 4 feet long. These tools must be of the latest and most modern design for handling work quickly; one man is expected to work both machines.

A Duplex boring machine with independent motions to bars and tables would be favorably considered. The machines would be inspected before being shipped; quick delivery is important. Send illustrations or drawings with lowest prices f. o. b. ship New York, to

The Campbell Gas Engine Co., Ltd, Halifax, England.

RUSSIA.

WOSSIDLO & CO.,

MERCHANTS AND ENGINEERS,
ST. PETERSBURG and... MOSCOW.

Represented in all important towns of Russia.

Contractors to the Imperial Russian Navy, Artillery, Railroad and Mining Department, Etc.

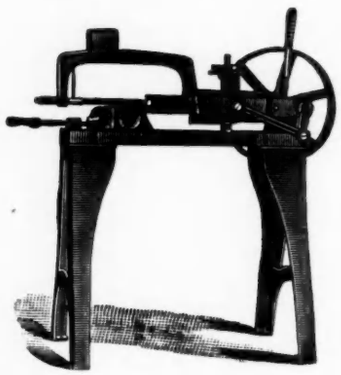
Are open to enter into correspondence with first-class American firms with a view to representing them in Russia, and request price lists of machinery and of all recent technical inventions.

"The best is as good as any."

The New

Automatic and Gravity Feed

Q & C Shop Saw



Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.

Price—'Way Down.
Quality—'Way Up.

Shop Saws,

Portable Rail Saws,

Cold Power Saws,

For All Purposes.

Send for Catalogue.

Q & C Company,

Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte.
MADRID: J. G. Neville & Co

has just purchased the plant of the March Hare Bicycle Company.

The Electrical Exchange last Saturday sold to Armour & Co. for use in several departments of their Chicago packing plant one 500 kilowatt generator, another of 200 kilowatts and a third of 100 kilowatts.

Kohler Brothers have recently placed an equipment of Northern motors in three printing establishments, as follows: A 40 horse-power direct connecting equipment for a Hoe press for the Omaha "Bee"; a 20 horse-power direct connecting equipment to an Ostrander press for the Peoria (Ill.) "Star"; a 15 horse-power direct connecting equipment for the Homestead Company, Des Moines, Ia.

▲ ▲ ▲

Quotations.

NEW YORK, Monday, August 22.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 25 @ 11 50
No. 2 foundry, Northern	10 75 @ 11 00
No. 2 plain, Northern	10 25 @ 10 50
Gray forge, Northern	9 75 @ 10 00
No. 1 foundry, Southern	10 75 @ 11 00
No. 2 foundry, Southern	10 50 @ 10 75
No. 3 foundry, Southern	10 25 @ 10 50
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 75 @ 11 00
Foundry forge, Southern	9 50 @ 10 00

Bar Iron—Base—Mill price, in carloads, on dock; Common, 1.05 @ 1.10c.; refined, 1.10 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.50c.

Cold Rolled Steel Shafting—Base sizes, from store, 2.05 @ 2.10c., according to quantity.

Copper—Carload lots: Lake superior ingot, 12¼c.; electrolytic, 12c.; casting copper, 11¾ @ 11⅞c. for ordinary brands.

Pig Lead—Carload lots, 4.05 @ 4.10c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 16¼c., f. o. b.

Spelter—Carload lots, 4.60 @ 4.75c., New York delivery, for common brands.

Antimony—In cask lots: Cookson's, 9⅝ @ 9¾c.; Hallett's and Japanese, 9c.; French E. B., and United States, 8¾c.

Lard Oil—Prime city, ice pressed, 46 @ 47c., in wholesale lots.

▲ ▲ ▲

Manufacturers.

Work on the new electric plant at Horn Pond, Mass., is going ahead in good shape.

Some new power machinery is to be placed in the Cleveland Cotton Mills, at Lawndale, S. C.

The Racine Malleable & Wrought Iron Company, Racine, Wis., whose plant was recently burned, is to be rebuilt.

There is in contemplation the erection of a cordage factory at Newbern, N. C., and Mr. James M. Harrison is interested.

The Atchison, Topeka & Santa Fé Railroad Company is erecting a boiler shop at Cleburne, Tex., to be 90x340 feet, of stone.

Bids are being received for the erection of a two-story granite, brick and terra cotta ordnance shop, 53.4 by 213.1 feet, at League Island.

McManus Brothers are about to erect a two-story brick extension to their business plant at Newark, N. J., 23 by 97 feet in dimensions.

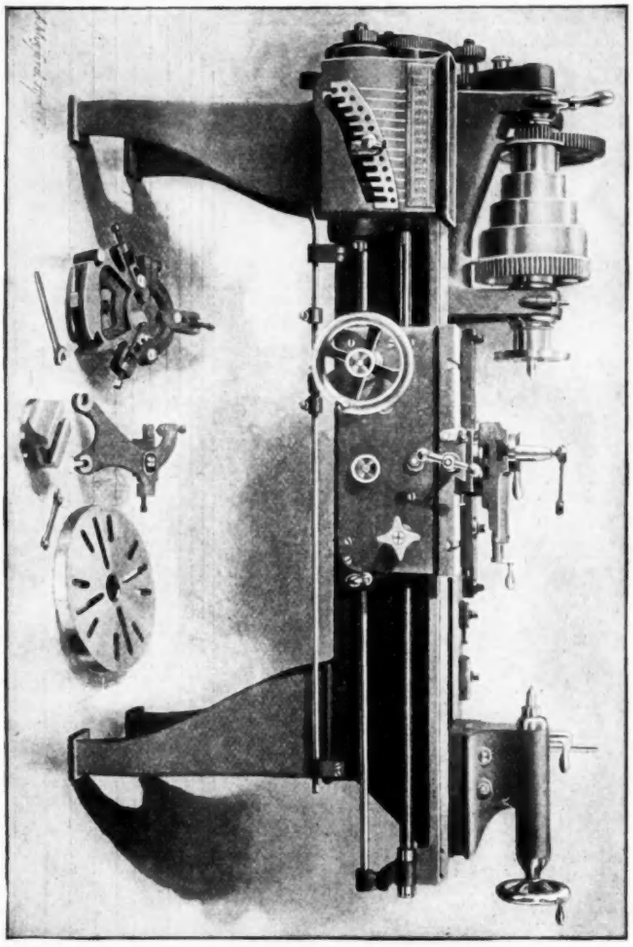
The Chicago Rail Joint Company, of Chicago, Ill., has been formed with $25,000 capital stock. The incorporators are A. W. Charles and J. F. Curtis.

Recently at Chesley, Ont., Biette & Co.'s steam sawmill was destroyed by fire. It is supposed the fire started in or near the furnace room.

The B. F. Goodrich Company, Akron, Ohio, will at once build an addition to its rubber plant. This is necessitated by the amount of business transacted by that concern. The new building will be of brick, one story high and

The Hendey Machine Co.,

Torrington, Conn.



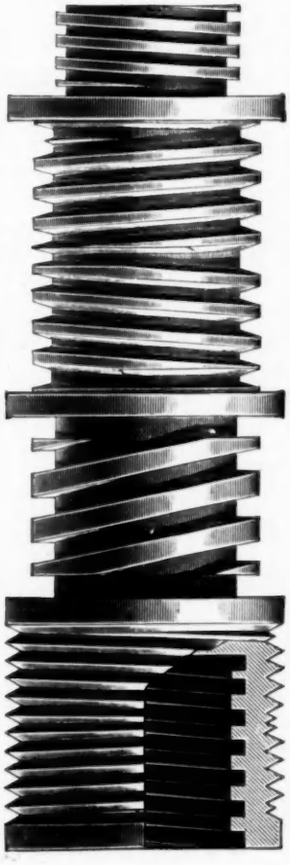
16 in. x 6 ft. Hendey-Norton Lathe.

• • • •

THE HENDEY-NORTON ENGINE LATHE is the most modern type of engine lathe extant. Why? Because it has the best improved attachments known for the rapid and accurate production of high-class lathe work in use on engine lathes at the present time.

One is the Norton arrangement of change gears for screw cutting. All the change gears are mounted in the gear box ready for use. The different pitches are obtained by the simple movement of handle in gear box from one notch to the other, carrying with it an intermediate gear meshing into the cone of change gears. Thus every thread required in ordinary use is obtained on the instant, and this applies equally well to the feeds.

Another is the reversing lever at side of apron. At the moment of changing travel of carriage, as when cutting threads, you have but to move up or down this lever when the *carriage*—not the countershaft, belt, head spindle and work—returns in the opposite direction, and so on till work is finished. This saves wear and tear on working parts.



In this specimen of thread cutting we have a good illustration of the application of the above features; but it is here shown to illustrate in particular what our Automatic Stop will do. It shows how threads can be cut to and from shoulders, both internally and externally, tool stopping to a certainty, and with work in motion. This feature is equally applicable in turning work in duplicate. The Automatic Stop is at once positive and simple.

AGENTS FOR THE PACIFIC COAST:
Pacific Tool & Supply Co., San Francisco, Cal.

J. W. Cregar, Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:
Schuchardt & Schutte, Berlin, Vienna, Brussels.
Chas. Churchill & Co., Ltd., London and Birmingham, Eng.
Adolphe Janssens, Paris, France.

150 feet long, and will be used for special purposes.

Work has been commenced on the new addition to the J. A. Schwab machine shop, Moundsville, W. Va. It is to be a three story structure.

The Crosby Manufacturing Company is building another addition to its mill in East Glastonbury, Conn. The new part will be four stories in height.

Work on the new addition to the New York Air Brake Company, Watertown, N. Y., will probably begin at once, as it is to be ready for occupancy before winter. The addition to be made is for foundry purposes.

The Morse Chain Company, Tompkins, N. Y., has purchased the remains of the Gregg Iron Works plant, at Trumansburg, N. Y., and will at once erect several buildings.

The Harden Manufacturing Company, of Harden, N. C., has decided definitely on the erection of an addition. The addition will be built of sufficient size to accommodate 2,000 spindles.

J. E. & J. H. Henry, of Lincoln, N. H., are doing an extensive business at Livermore Falls, at the south part of the town, blasting rock, etc., preparatory to erecting a mill building for manufacturing purposes.

A permit was issued recently for the Western Electric Company to erect a new ten story factory at 259 to 275 South Clinton street, Chicago. The building will be of brick, 180 feet wide, 96 feet deep, and will cost $150,000.

Articles of incorporation have been filed by the Walters Manufacturing Company, Camden, N. J., with a capital stock of $250,000. The object of the corporation is to manufacture automatic dryers for extracting liquids from solids.

At a recent meeting of the directors of the Richmond Mills, Lewiston, Me., manufacturers of cotton yarn, it was voted to expend $12,000 in improving the property. Another story will be added to the building and other improvements made.

The James P. Lewis Company is preparing to rebuild their mill at Beaver Falls, Pa., which was destroyed by fire a short while ago. The new mill complete will cost about $70,000, and pulp, paper and torchon mat board will be manufactured.

The Daimler Manufacturing Company has acquired all the real estate and personal property, plants, machinery, patent rights and book outstandings of the former Daimler Motor Company, and will continue their business with enlarged facilities.

A fire occurred in the main building of the Jenckes Machine Company and Canadian Rand Drill Company, Sherbrooke, Que., recently. The building is over 300 feet long by about 100 wide. The estimated loss is from $200,000 to $250,000, and is partially covered by insurance. The employés, who had all their tools in the building, lose heavily, as they carry no insurance.

Drawings are in preparation at the office of M. S. Ritter, the architect, for the main building of the Lycoming Silk Mill, Newberry, Pa., which will be four stories in height, constructed of brick, and have a frontage of 200 feet and a depth of 45 feet. Work upon the foundations of the above building will be commenced at once.

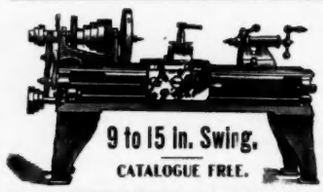
Mr. Geo. R. Dana, who has been superintendent for the past thirteen years of the well-known machinery dealer, the late Jeremiah Clark, of Lowell, is now doing business on his own account and has opened an office at 16 Thorndike street, Lowell. Mr. Dana will make a specialty of handling cotton ond woolen machinery.

The Schoen Pressed Steel Company, of Woods Run, Allegheny, Pa., has commenced the erection of an addition to their large plant, which, when completed, will give employment to several hundred additional men. The new building will have a frontage of 120 feet on Preble avenue and will extend back to the present works, a distance of 708 feet. The building will be one story.

HOLDERS WITH INSERTED CUTTERS,

For turning, cutting off, threading, shaping and boring metals. The cutters are inexpensive and may be sharpened by grinding, without changing the form.
MILLING CUTTERS, in variety, carried in stock and made to order. Punches and Dies for plate work. Taps, Dies, Reamers, Gauges.
ASK FOR THE MACHINISTS' CATALOGUE.

The Pratt & Whitney Co., Hartford, Conn., U. S. A.
New York, 123 Liberty Street. Boston: 144 Pearl Street. Chicago, 42 South Clinton Street. London, Eng., Buck & Hickman, 280 Whitechapel Road. Paris, France, Fenwick Freres & Co., 21 Rue Martel.



ENGINE and SPEED LATHES
IN VARIOUS LENGTHS—9 to 15 in. SWING.
Latest and Most Approved Designs. Workmanship, Material and Finish of the Highest Order.
SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, CINCINNATI, OHIO, U. S. A.
Agents: Selig, Sonnenthal & Co., London, Eng.; John Tragardh & Co., Goteborg, Sweden; E. Sonnenthal, Jr., Berlin, Germany; R. S. Stokvis & Zonen, Rotterdam, Holland.

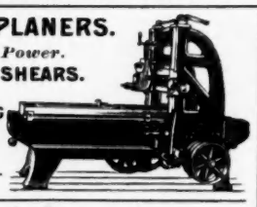
AN ELEMENTARY COURSE IN MECHANICAL DRAWING.
By John S. Reid, Instructor in Mechanical Drawing and Designing, Sibley College Cornell University, Ithaca, N. Y. First edition, first thousand. 8vo. v + 128 pages, 168 figures. Cloth, $2 00. Order through your bookseller, or copies will be forwarded postpaid by the publishers on receipt of the retail price.
JOHN WILEY & SONS, 53 East 10th Street, New York City.

Full Mounted Lightning Screw Plate.

A STOCK WITH EACH DIE.
Also "Lightning" and "Green River" Screw Plates, Dies, Taps, Tap Wrenches, Bolt Cutters, Drilling Machines, Punches, Presses, etc.
. . Send for Catalogue . . .
Wiley & Russell Mfg. Co. Greenfield, Mass., U. S. A.
Agents in London, Selig, Sonnenthal & Co., 85 Queen Victoria Street.

WE CLAIM THE FOLLOWING MERITS FOR JENKINS BROS.' VALVES.
1. Manufactured of the best Steam Metal.
2. No regrinding, therefore not constantly wearing out the Seat of the Valves.
3. Contain JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.
4. The Easiest Repaired, and all parts Interchangeable.
5. Every Valve Tested before leaving the factory.
6. ALL GENUINE stamped with Trade Mark.
JENKINS BROTHERS, New York, Philadelphia, Chicago, Boston.

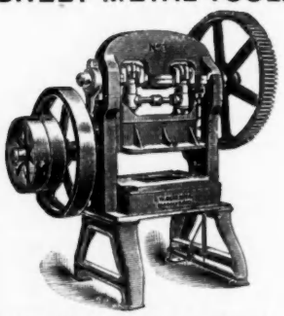
WHITCOMB PLANERS.
Hand and Power.
PUNCHES AND SHEARS.
WHITCOMB MANUFACTURING COMPANY,
Worcester, Mass.
English Agts., Selig, Sonnenthal & Co., London.



Lathes.
LODGE & SHIPLEY MACHINE TOOL CO.,
Cincinnati, Ohio.

Diamond Grinders
are all right.
Send to us for a catalogue.
Diamond Machine Co.,
Providence, R. I.
Chicago, Ill.

E. W. BLISS CO.
1 Adams St., Brooklyn, N. Y.
Western Office: 96 W. Washington St., Chicago, Ill.
European Office: 39 Rue Caumartin, Paris, France. A. Wilzin, Manager.
SHEET METAL TOOLS.



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PRESSES, DROP HAMMERS, DIES AND SPECIAL MACHINERY.
OWNERS OF
THE STILES & PARKER PRESS CO.
Manufacturers of the WALDRON FRICTION CLUTCHES.

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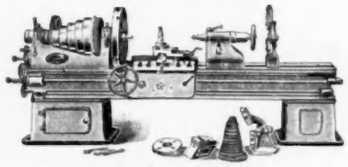

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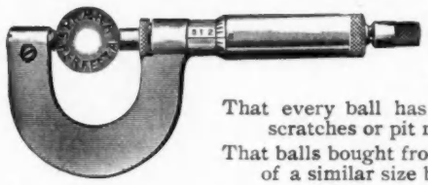

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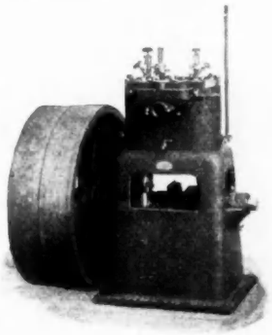

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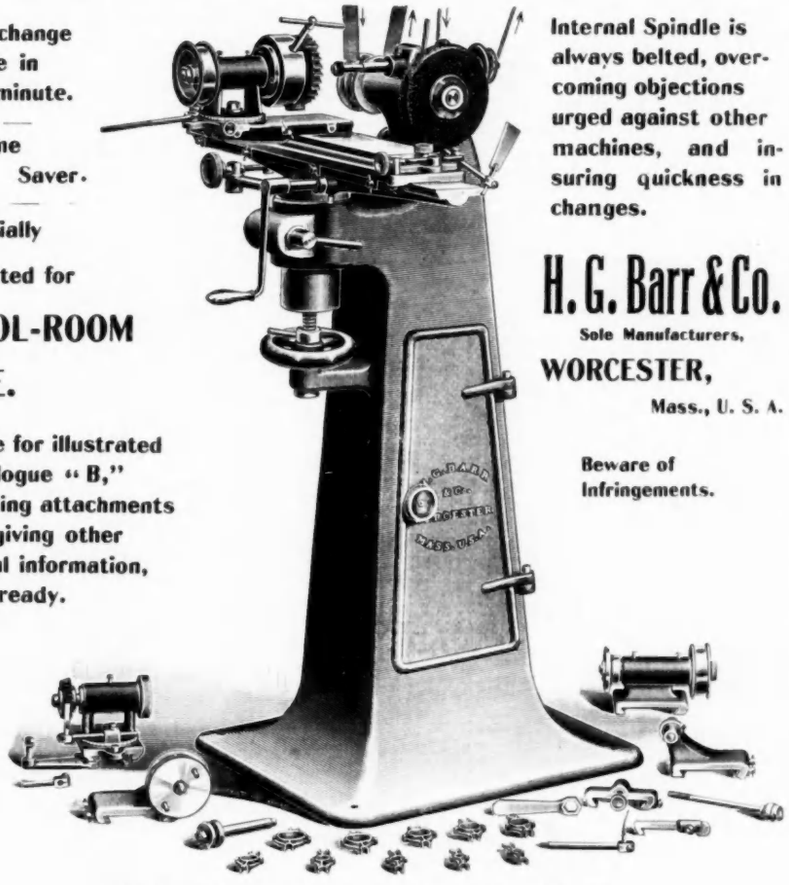

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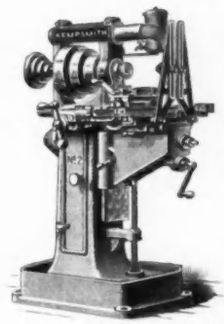

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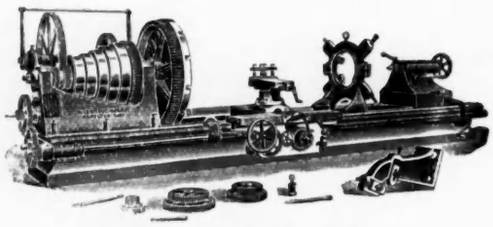

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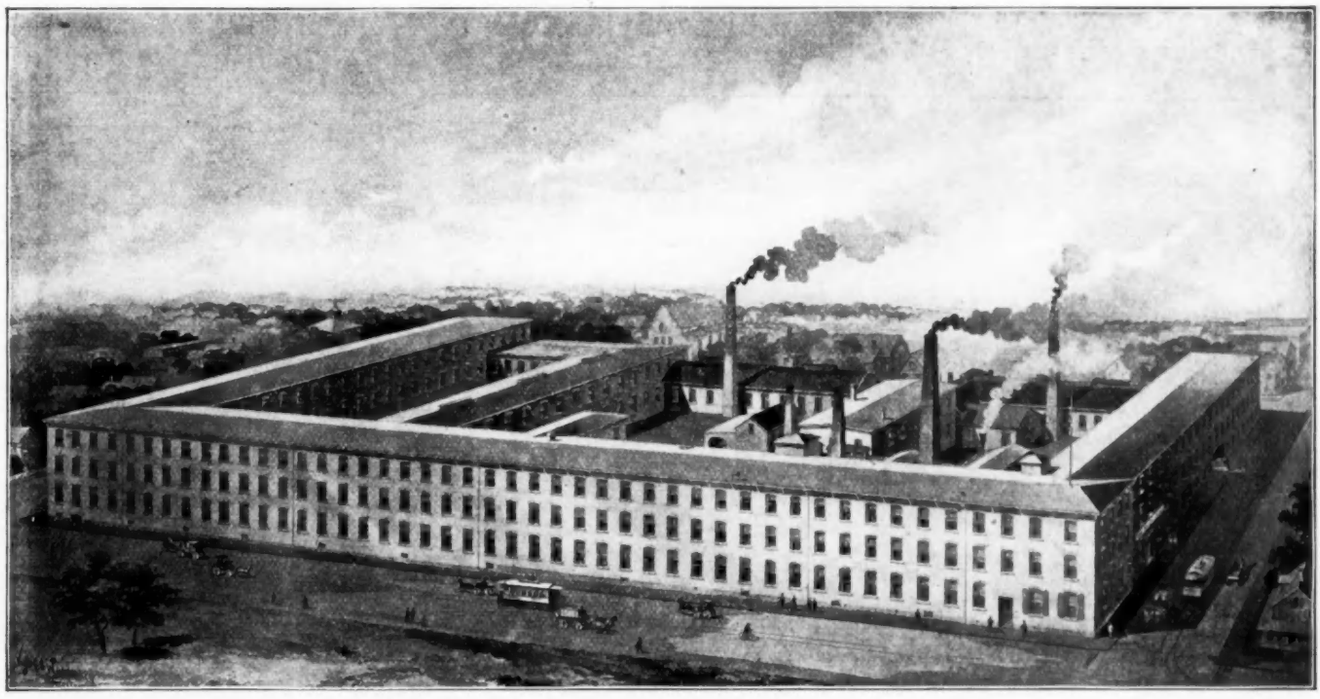

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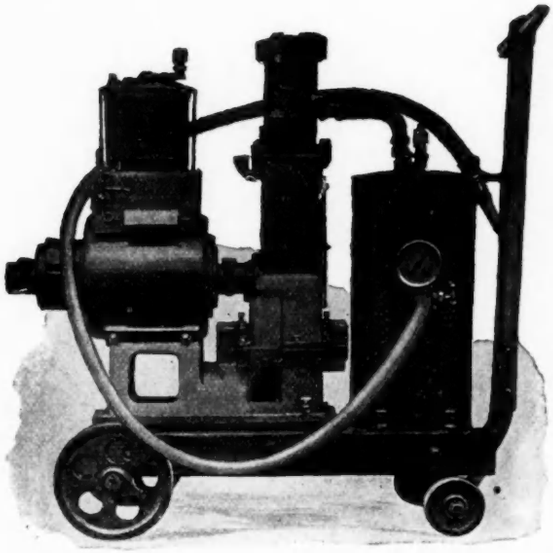

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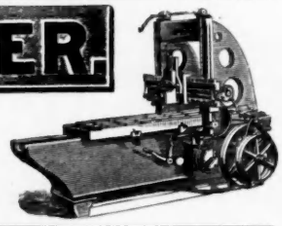

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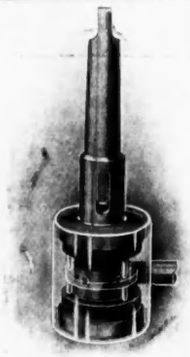

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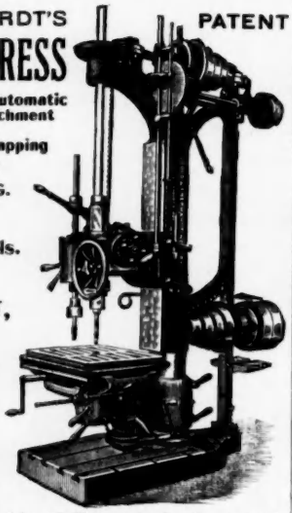

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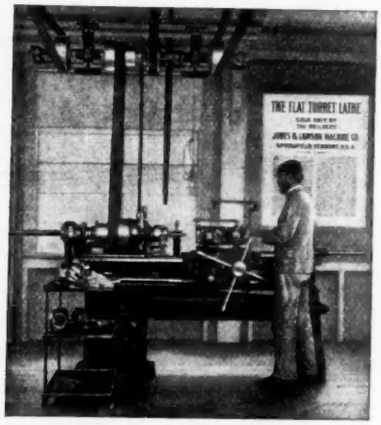

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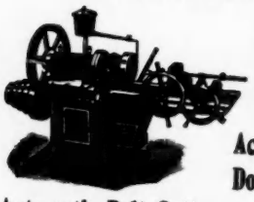

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